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UNIVERSITY OF SOUTH CAROLINA
ENGINEERING CENTER

Samuel B. Herin

Samuel B. Herin Spring 1984

A terminal project submitted to the faculty of the College of Architecture, Clemson University, in partial fulfillment of the requirements for the degree of Master of Architecture.

[redacted]

PETER LEE, Committee Chairman

[redacted]

TEOMAN DORUK, Major Critic

[redacted]

JOSE CABAN, Committee Member

[redacted]

J. CHARLES JENNETT, Committee Member

[redacted]

FREDERICK G. ROTH, Committee Member

[redacted]

KENNETH RUSSO, Head of Department of Architecture

[redacted]

HARLAN E. McCLURE, Dean, College of Architecture

ACKNOWLEDGEMENTS

My parents and Tamie must be thanked for they made the sacrifices. I wish to thank Mr. David Rinker of the University of South Carolina for his help in establishing this project. I must also thank Dean Charles Jennett and the Clemson University College of Engineering for their practical and technical advice. Thank - you's are extended to Teoman Doruk and my committee, my friend Dean Harlan McClure for his encouragement and understanding, Tamie (again) and Dee Dee Mathews for their labor!

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THE PROJECT

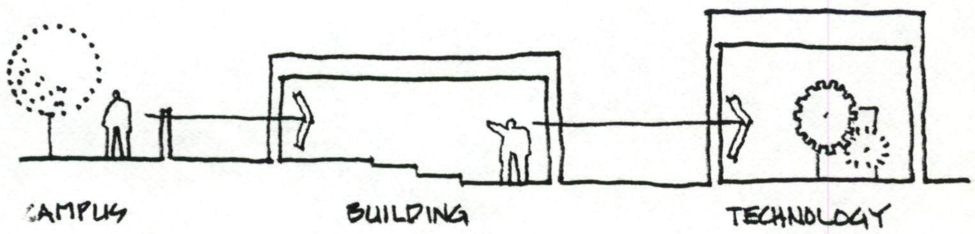
PROJECT DESCRIPTION

The University of South Carolina College of Engineering, founded as the School of Natural and Mechanical Philosophy in 1856, has experienced a steady growth in recent years. The College has occupied the Sumwalt Engineering Building since 1953 and is faced with the need for a new facility that will accommodate growing enrollments and changing needs in engineering education. It is estimated that enrollment figures will double by 1990 with the increasing demand for more engineers in the state. University of South Carolina administrators and leaders in industry support the move to a new facility that would exemplify contemporary ideals in engineering education and technology.

Founded in 1801, the University of South Carolina has experienced times of periodic campus growth, the latter occurring in the period since 1950. Because of its urban setting in the capitol city, expansion has become difficult. The existing engineering building is situated in the central campus area on a site which offers no possibilities for growth. A new site, therefore, must be found for the proposed complex. This terminal project will determine an appropriate site for the new Engineering Center, establish a program of needs for its activites, and develop a design proposal responsive to urban, functional, and technological criteria.

PROJECT APPROACH

The approach to this project will develop from background information towards more specific architectural considerations. Historical context, engineering school activity, resources, and needs of the facility will establish a basis for the project's development. The approach and design will be separated into three levels: the campus, campus building, and technology.



The problem requires an understanding of campus activity in an urban setting. The University of South Carolina represents an active community within the city. This mini-culture requires activity and communication between the educational disciplines. Here, the movement of people must be considered within the imageable physical environment of urban space. A response to campus design must be made by reinforcing its physical image.

The college building is an interior response to the activity on a campus. The Engineering Center must respond to this exterior/interior transition for visitors, students, and faculty. On campus, it must relate to the demands of engineering education and represent a center of student learning. Faculty and student spaces must interact with the other in an order that is conducive to teaching and learning.

The quality of engineering education depends upon adaptability to changing technology. Equipment and systems place critical demands upon the architecture. A key factor in dealing with technology is a broadly defined one: flexibility. Flexibility of technological activity, space, and systems must be considered.

ENGINEERING EDUCATION ISSUES

There are many problems in engineering education today as expressed by educators and industry professionals. Current writings pertaining to engineering education focus on better interdisciplinary activity in the University, increased emphasis on cooperative goal structures for students, and a better qualified faculty that can relate pertinent work experience to education. Laboratory conditions should also be conducive to current educational philosophies and contemporary technological application. The emphasis in each of these areas must relate to the engineering school's main purpose: education.

SOCIAL-TECHNICAL COMPETENCE

Changes in engineering education occurring over the next ten years will focus on the engineer's social-technical competence. It is felt that since World War II the emphasis in education has shifted too much toward engineering science. The curriculum will involve an increase in historical, social, environmental, and ethical context in the teaching of engineering. This involves an understanding of the basic premises underlying the interaction of society and technology. The student must be introduced to forces and conditions that precede and the effects that follow an engineering discovery. This attitude can be reinforced by an engineering center that is sited to encourage campus interaction.

While engineering students are mastering technological skills, they need to interact with one another in ways that promote interpersonal and social-technical competence. There must be room to encourage innovative design. Instructional goal structures used to accomplish this must be both cooperative and competitive. Competitive and individual goal structures deny students an interactive educational environment. With cooperative goal strucures, students can rely on one another for resources to attain goals. In this instance, the architect can encourage this type of activity by providing more group areas in the building where applicable.

FACULTY PROFICIENCY

Another problem within the field of engineering education is faculty proficiency. Education, focusing on real world problems, is a major objective of an engineering school and too often faculty members possess little industrial experience. National figures show that forty percent have less than two years work experience. Although research makes up for this deficiency, research professors often have little classroom exposure and even less undergraduate laboratory experience. This gap between education and industry must be narrowed in the engineering school faculty. Close relations between research and education as well as physical links between outside industry and education are necessary.

LABORATORY INSTRUCTION

Laboratory instruction is a critical aspect of engineering education. Therefore, it is necessary for the undergraduate instructional laboratory to meet the needs of the faculty, as well as the needs of the engineering student. The faculty must be directly involved with their work in the laboratory and at the same time be involved with the student's laboratory education. The lab should also help the student gain insight into the real world. If the laboratory serves as a means of continuing professional development for the faculty member, then the student may be motivated to continue his educational development alongside his educator.

Laboratory skills are dwindling in the undergraduate labs, and an increase in student motivation can be made with more pertinent project work. Project work, or learning by exploration, is very powerful and parallels the way in which most general engineering laws are discovered and formulated. Therefore, the laboratory must stay on the leading edge of development by meeting the physical need of technological change.

PROFESSIONALISM

Professionalism, ethics, and social concerns in engineering education should not be pushed out of the curriculum by materials science, calculus, and strength of materials. However, professionalism is often left to training on the job. With better links to industrial professionalism and technology, schools can effectively teach these much needed aspects of engineering.

CONCLUSION

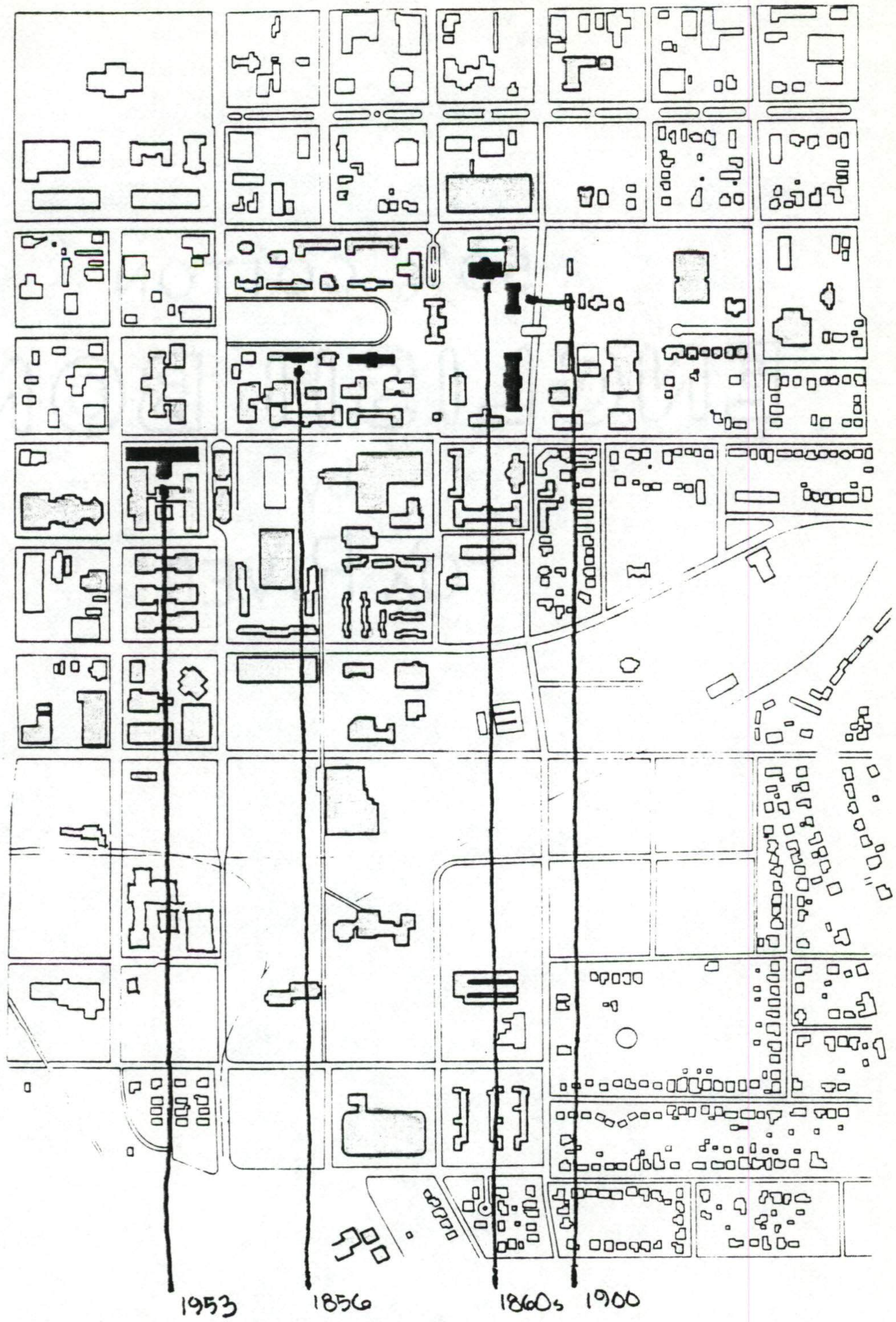
The architecture of a university engineering center can have a positive impact on these issues. Significant changes responding to the problems of engineering education will have to come from external pressures. The Accreditation Board of Engineering and Technology (ABET) seems to be best suited for development in these areas, along with members of the engineering profession. The architectural influence is threefold. First, proper architectural relationships between the university, college, and profession must be formed. Second, architectural imagery and function must respond to student and faculty interaction. Thirdly, engineering education requires architecture to keep pace with engineering technology. The architecture must respond not only to the classroom-lab/student-faculty relationship, but also to physical technological change.

THE COLLEGE OF ENGINEERING

DEVELOPMENT AND BACKGROUND

Engineering education first came to the South Carolina College with the arrival of the LeConte brothers in 1856. John LeConte chaired the School of Natural and Mechanical Philosophy and Astronomy, which taught a theoristic approach to elastic and solid mechanics. The formation of the School occurred during the latter part of the industrial revolution and reflected man's fascination with the machine. The School of Mathematics, Civil and Military Engineering, and Construction began in this important period of engineering development. At this time, the school offered B.S. degrees in civil and mechanical engineering. The largest enrollment of this period was in civil engineering with surveying, architecture, and stone cutting as options. In 1880, the school rechartered under the name of the College of Agriculture and Mechanic Arts. To place the period in historical context, Westinghouse was developing A/C power generation in 1886. Coincidentally, Westinghouse helped develop the world's first electrically powered textile mill using hydroelectric generators in Columbia before the turn of the century.

A second state college was formed by Thomas Clemson and Benjamin Tillman at Fort Hill in 1889. The Clemson College charter provided for education in the agricultural sciences with equal importance in engineering studies. As a consequence, the engineering programs in Columbia were discontinued and all equipment was sold or transferred to the new college.



ENGINEERING SCHOOL DEVELOPMENT

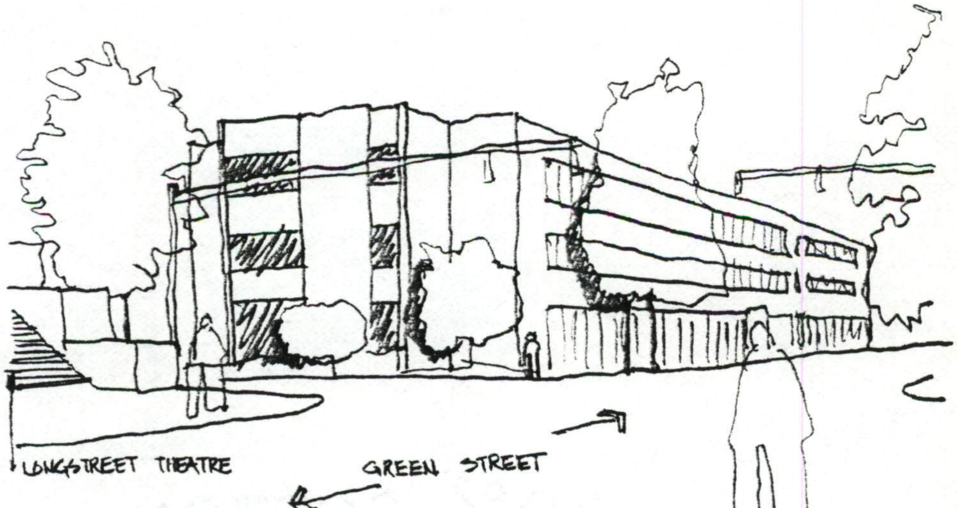
In 1894, engineering programs were reintroduced to the Columbia campus with degrees offered in civil, mechanical, and electrical engineering. The latter course of study was introduced only eight years after Westinghouse pioneered A/C generation. At the beginning of the twentieth century, graduate course work was introduced in civil and electrical engineering. During World War II the University became a war community. Military engineering, navigation, construction, electronics, and other wartime concerns were researched and taught at this time. Major growth occurred in the program during the post-war period with the establishment of a separate College of Engineering. The Sumwalt Engineering Building was completed in 1953, and chemical engineering was added to the programs offered in civil, mechanical, and electrical engineering.

Today, the University of South Carlina and Clemson University each have colleges of engineering which offer undergraduate and graduate programs. The following chart compares the offerings of the two universities. The demand for engineers in South Carolina not only justifies engineering programs at each school, but calls for expansion as well. With the predicted annual growth rate for engineering jobs in South Carolina in excess of 20%, USC alone would have to triple its number of graduates to meet this need.

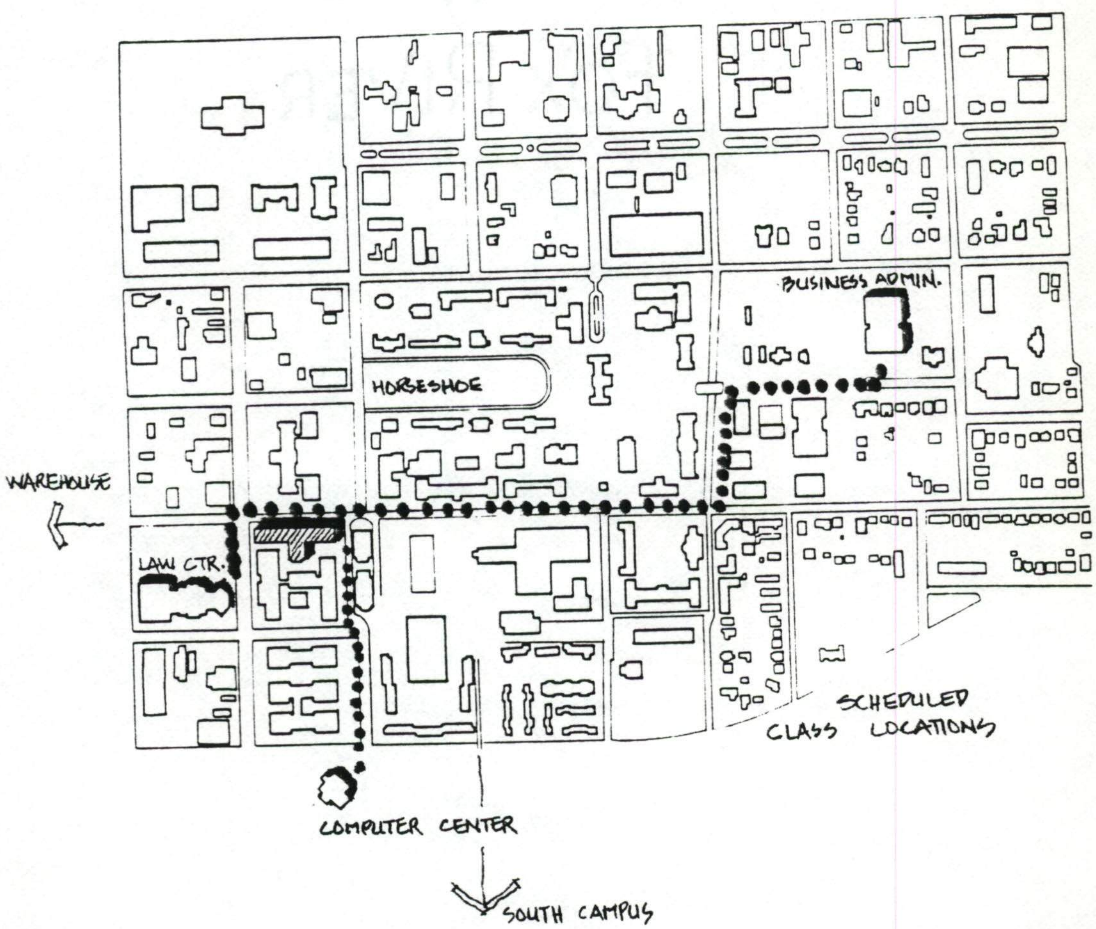
	AGRICULTURAL	CERAMIC	CHEMICAL	CIVIL	ELEC. & COMPUTER	INDUSTRIAL	MECHANICAL	TECHNOLOGY	BACHELOR	MASTERS	DOCTORATE
UNIVERSITY OF SOUTH CAROLINA			●	●	●	○	●	○	●	●	●
CLEMSON UNIVERSITY	●	●	●	●	●	●	●	●	●	●	●

FACILITIES

USC's engineering program has occupied five facilities on the campus during its evolution from a school of mechanics philosophy to an accredited College of Engineering. The College has been in the Sumwalt Engineering Building since 1953 and has experienced overcrowding for a number of years. In 1959, this building was expanded to accommodate more laboratory space, creating a total of 113,500 square feet. Currently, most classes are held in the present engineering building, but some must be scheduled in the Law Center and the Business Administration School. Laboratory space is in short supply and the space that is available is not easily adaptable to changing technology.



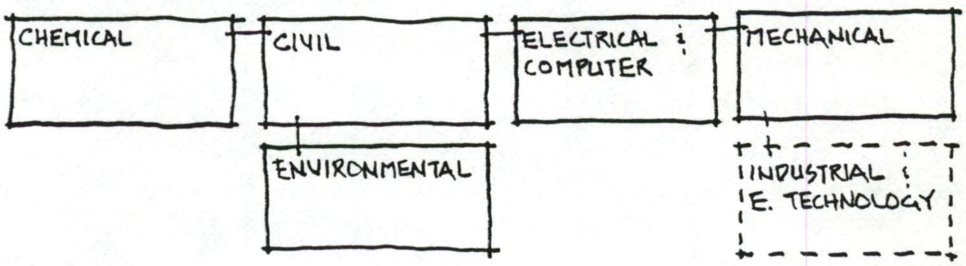
SUMWALT ENGINEERING BUILDING, 1953.



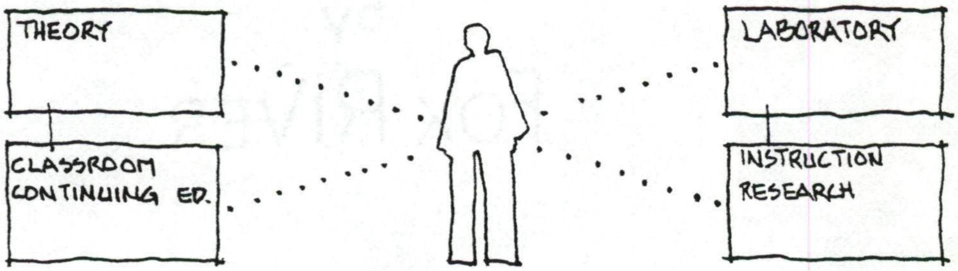
Recently, the College rented warehouse space at 801 Green Street to accommodate laboratory areas. A major need for the additional space resulted from the introduction of the computer in recent years. Electrical engineering programs have expanded to encompass computer engineering, and this has made a once small department the largest department of the College. Use of the computer model in engineering design has increased and the present facilities do not have adequate computer areas for use near the laboratories. Enrollments will double in the next ten years, so classroom space and office space must be provided. The administration is committed to developing new facilities that will not separate the departments of the College.

PROGRAMS

The College of Engineering's objective is to provide professional education in engineering through separate departments that focus on the major areas of engineering. There are four basic fields represented in the College of Engineering: Chemical, Civil, Electrical and Computer, and Mechanical Engineering. The curriculum of each department offers specialized engineering courses and exposure to the sciences and humanities. Although departments operate separately, facilities and resources are often shared.



The College operates various programs within the departments. The largest is an undergraduate program consisting of theory and laboratory instruction. Post-graduate and continuing education programs are offered while research programs are maintained within the College.



The undergraduate program at USC offers a core curriculum in the first two years with specialized coursework in the final two years. A Bachelor of Science degree is offered in each of the major areas of study. The syllabus includes a balanced course load between engineering, science, and the humanities in the first two years. A complete range of theory is taught in the classroom and computer models are used for engineering design and computations.

Graduate and doctorial degrees are also offered. A recommended course of study is offered for the Master of Sciences degree. However, approved thesis and research outlines are followed for the Master of Engineering and PhD degrees. A major part of the graduate program deals with the off-campus student, where students are allowed to conduct approved research while working in industry.

The College of Engineering is a proponent of the use of technology for education. A Program of Graduate Engineering Education (APOGEE) is offered in the College. The program offers all graduate credit courses on video. The video is available to all on-campus students as well as off-campus students, most of whom are graduate students. USC's APOGEE program is one of the largest of its kind in terms of the number of degrees offered.

The College will maintain its own continuing education center and will be part of the university-wide network. This program will allow direct classroom and laboratory experience to the professional wishing to stay current with engineering issues.

A far reaching aspect of USC's Engineering School will be that of the graduate and research program capabilities. Within each department, research is conducted for industry and others concerned with technological development. In research, faculty and students gain valuable work experience.

In South Carolina, there is a definite need for expanded programs in these areas. Engineering enrollments have risen, on the national average, 70% over the last four years, and resources have not matched this growth. USC roughly expects to double its number of students in the curriculum over the next ten years, and it cannot deny facility resources to its students if it is to provide competent engineers for society. The following chart shows the enrollment figures of the College of Engineering at USC.

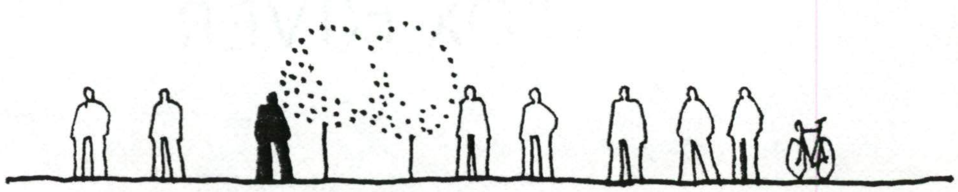
ACTIVITY IN THE COLLEGE OF ENGINEERING

The understanding of activity in the College of Engineering will focus on four main areas. A campus overview will define relationships to other departments that are within the College's ring of activity. Secondly, interaction within the college will be discussed. The third and fourth areas of activity will cover the activities of students and faculty.

CAMPUS ACTIVITY

The College of Engineering will interact with different departments on campus. The College encourages faculty and students to be involved with the university community on academic and extra-curricular levels.

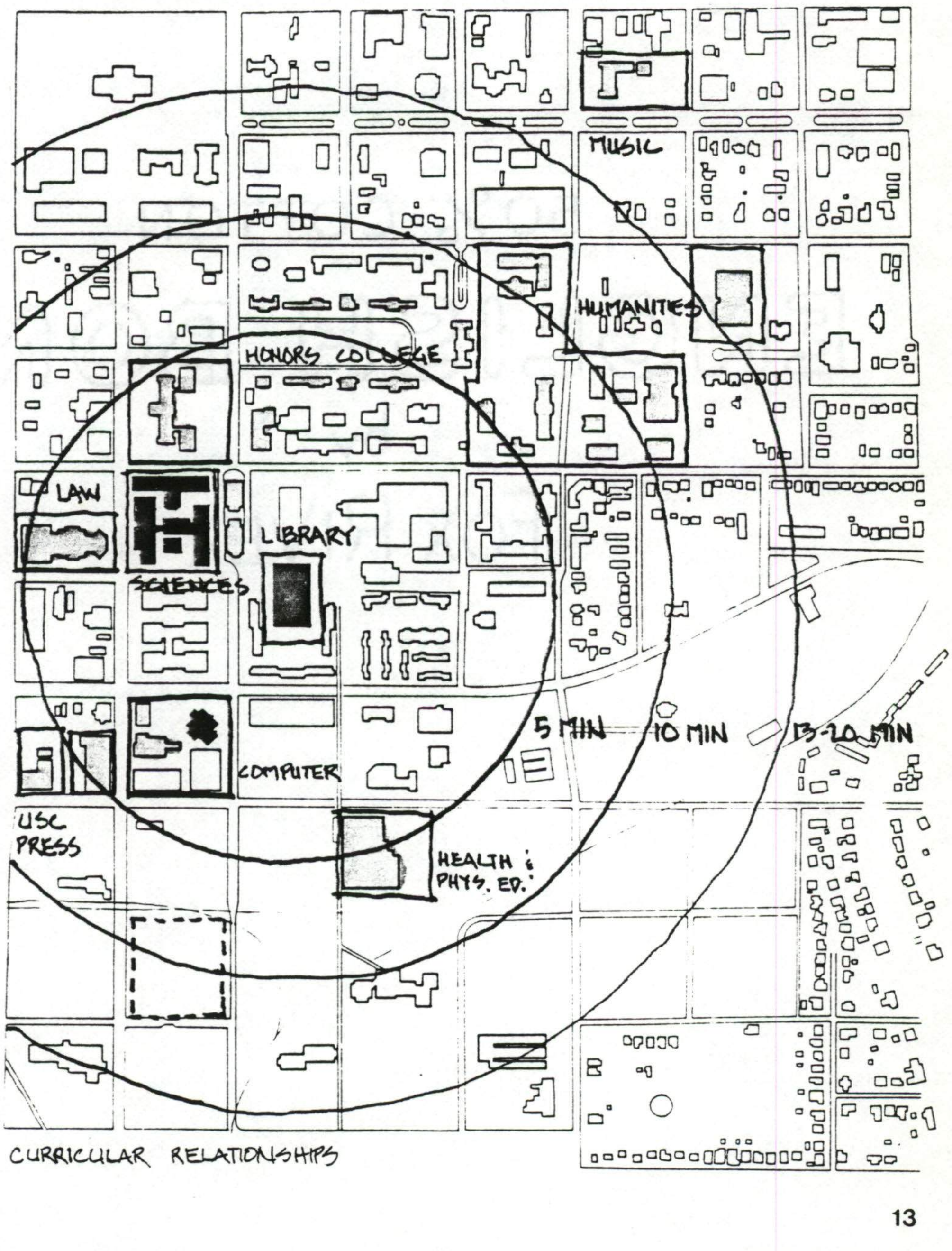
The University of South Carolina's Columbia campus is composed of over 26,000 students, and within the next few years over 3000 students will be enrolled in the College of Engineering. These figures demonstrate that one of every eight students on campus will be an engineering student. This will cause the College of Engineering to have one of the largest student populations on the diversified campus.



THE ENGINEERING STUDENT

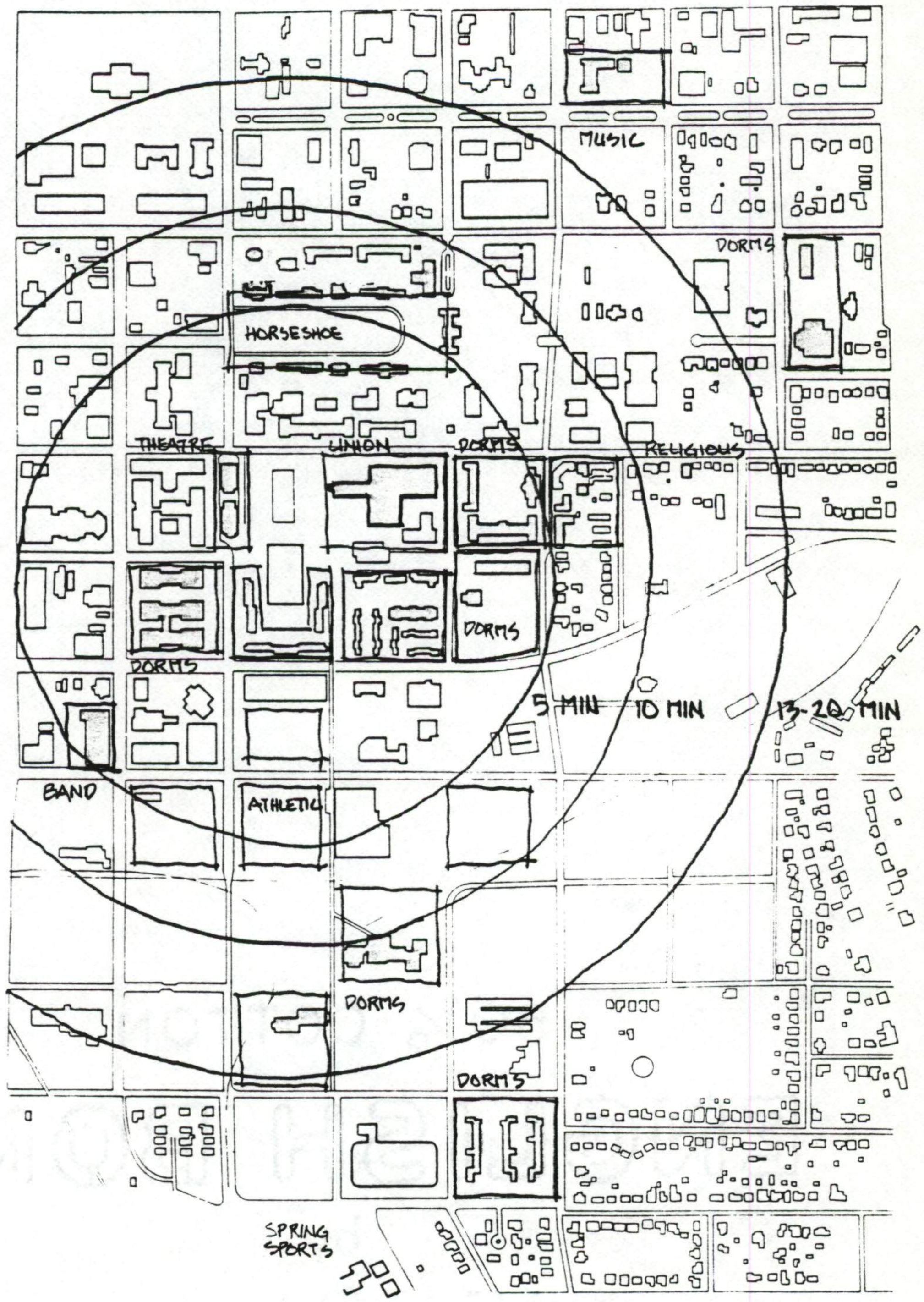
There are important activity links between the College of Engineering, the sciences, the computer facility, and the humanities. Students in the program will be taking classes in the science departments, the business school, and the humanities. A portion of the students are involved in the South Carolina Honors College and will be taking classes in the Horseshoe area. Though classes are taken elsewhere on campus, the engineering student thinks of the College as an educational base of activity.

Faculty members are also involved on campus in academic matters outside of the College of Engineering. Professors will participate in joint research programs with other departments, especially in the sciences. Faculty will have contacts with the university press and library, thereby creating activity outside of the College.



CURRICULAR RELATIONSHIPS

Almost all students are involved in at least one non-curricular activity on the campus. Students are involved in student government, intramural sports, and religious and social groups. In their leisure, students often utilize open spaces on campus for recreation. A portion of the student body lives on campus. Out of every four students on the campus, one will be a resident student.

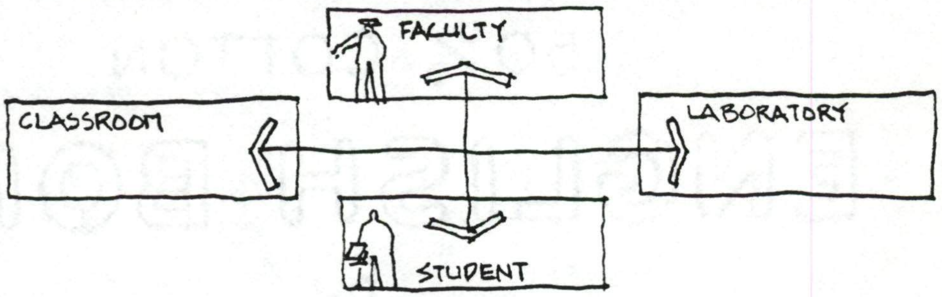


NON-CURRICULAR RELATIONSHIPS

Methods of movement on campus vary. Walking is common for short trips on campus, yet many students and faculty utilize the campus shuttle service for longer distances. Walking times average ten minutes with longer distances requiring up to twenty minutes. Faculty tend to park in assigned spaces near their departments, while students park either in designated areas at the perimeter of campus or in rented spaces in University-owned garages.

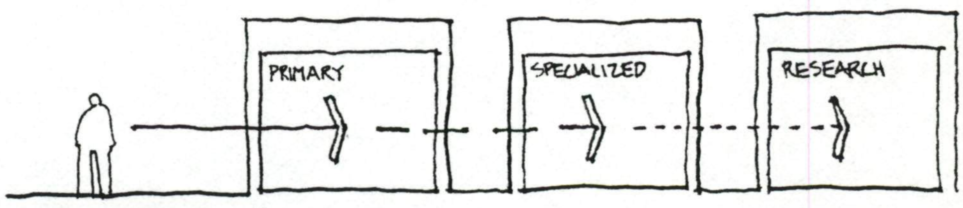
COLLEGE ACTIVITY

Activity relationships within the College of Engineering should promote a better interaction between the classroom and laboratory. Students should be encouraged to use both instruments of learning: theory and laboratory experience. At the same time, faculty should participate in classroom and laboratory activity so that the student sees both practical and theoretical applications of engineering.



Certain activities are common to all departments. Information distribution and retrieval are important in this respect. Library resources and materials are needed by both student and faculty. Interaction with computers is a common activity found in the engineering school, and spatial arrangements should be conducive to this relationship. Convocations, meetings, demonstrations, and lectures are traditional educational activities found in the school.

Laboratories are under the supervision of faculty, staff, and teaching assistants depending on the type of activity. In teaching laboratories, lab technicians and teaching assistants (T/As) will conduct laboratory activity under the direction of a professor. Activity in the laboratories will depend upon their classification as a primary teaching lab, a specialized lab, or a research lab.



LABORATORY ACCESS

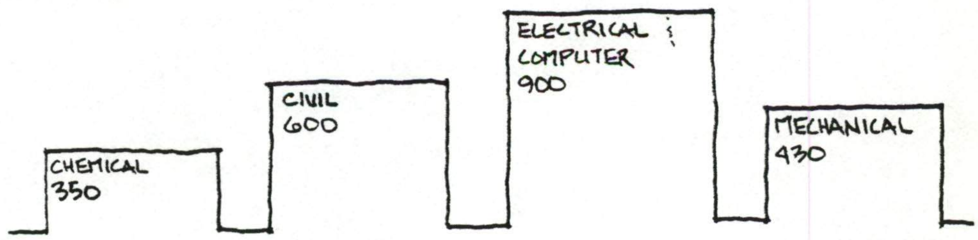
UNDERGRADUATE STUDENT ACTIVITY

Within the College of Engineering, the undergraduate student's role varies with his year level. The first two years of the core curriculum focus on classroom activity. The first year student has two classes in the humanities, two in the sciences, and one in engineering. A graphics lab is taught to all freshmen one hour per week. Student interaction is developed at the common year level, thereby increasing interaction between the disciplines of upperclassmen. Second year students increase their amount of coursework in the engineering school to two of five classes in the schedule. The amount of study time in the sciences remains the same at this year level. Humanities then comprise only one fifth of the class schedule per semester. By the junior year, the student begins specific theory study within his major, and laboratory time also increases. The senior year is similar, yet at this time there are no required humanities courses, and most work is done within the college.

	THEORY GENERAL LAB 1-2		THEORY SPECIALIZED LAB 3-4	
ENGINEERING	1/5	2/5	2/5	4/5
SCIENCES	2/5	2/5	2/5	1/5
HUMANITIES	2/5	1/5	1/5	-

Classroom and lab activities are of equal importance in engineering education. Classroom activity includes lectures, taped lectures, visual presentations, and demonstrations. Teacher:student ratios in the class vary from 1:30 to 1:400, while the average classroom holds sixty students to every professor. Equally important is laboratory activity. The lab offers students group experience and technological experience. Certain major labs will have room for lab instruction to groups of students. Most of the labs are specialized so that research work can be experienced by faculty, graduate students, and undergraduates in a stacked arrangement. A limited number of students do work/study research for faculty and this requires crossing lines of activity between the professor, lab technician, and student.

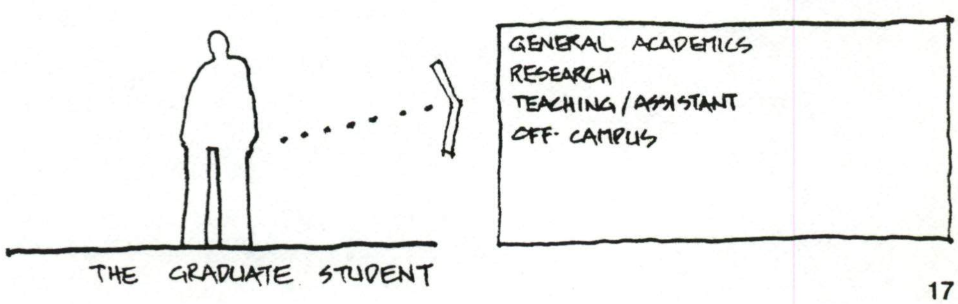
The College's student population is proportionate to the overall size of each department. It is projected that electrical and computer engineering will be the largest department with 900 students. Civil engineering students will number 600, mechanical engineering will consist of 430 students, while chemical engineering will house 350 students.

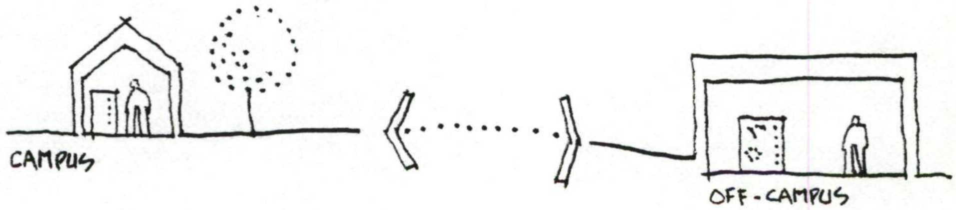


Non-curricular activities for the engineering student are important for a balanced education. USC's engineering societies are very active. Students meet in lounges between classes to rest and exchange ideas. These spaces promote activity and interaction between students. Each engineering society is independent, yet students are encouraged to interact between the disciplines.

GRADUATE STUDENT ACTIVITY

There are basically four different types of graduate students: those involved in research, teaching assistantships, general academic pursuits, and off-campus study. The percentage of students in each category will vary from year to year. The activity common to graduate students is the work area. Tasks in these areas include studying, paper writing, and administrative duties of any work study or assistantship. The student work areas should be convenient to the faculty and accessible to the student at all times. Graduate students also work with undergraduates when acting as a T/A. Areas of activity will include computer facilities, research labs, the library, and the classroom. Laboratory access will be limited depending on the lab type and faculty approval. While studies will be concentrated at the engineering center, the graduate student may be in contact with the computer center, science facilities, and any departments relating to specific research.

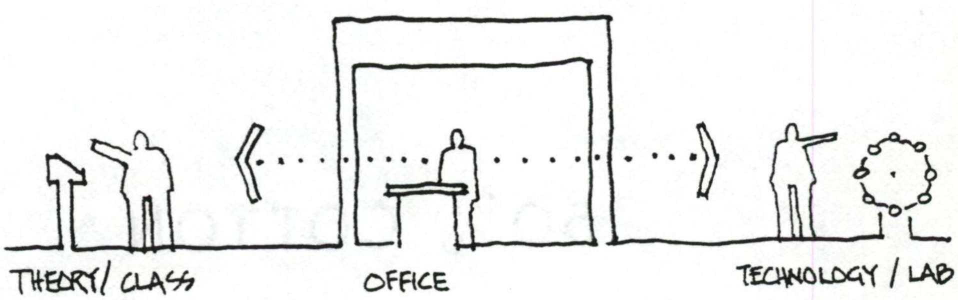




The off-campus graduate student population will have no impact on classroom space. These approximately 1000 students would visit the campus only three times per semester for evaluation, personal instruction, and advising. Certain activities would occur in the center as a result of this program. This includes the processing of correspondence materials and video production.

FACULTY ACTIVITY

The faculty organization is relatively simple. The Dean and his administration organize the overall goal structure of the College of Engineering. The administration should be accessible by faculty, students, and visitors for conferences and meetings. An assistant dean acts as an advisor to students. An advising staff and business office completes the administrative branch. A department head is responsible for the activities within each field of study. The faculty of each department should be allowed contact with this person. Conference and T/A areas should be accessible by the faculty member. Also, each department will have secretarial areas. Faculty will be involved in teaching, research, advising, administration, and conference activities in the college. Office facilities should relate to the classroom and laboratory. Teaching and research faculty should be grouped to interrelate their roles in the school.



OTHER ACTIVITY

Finally, off-campus visitors and students have a different impact on the building activity. Entry to the building should be clear and barrier free with obvious public spaces. Most all visitors will arrive by car except those visitors associated with the University. Visiting professionals will arrive for research conferences and continuing education. Generally, visitor contact with technical areas would be under supervision.

Testing and research involve the arrival of materials and equipment to the center. The service activity, therefore, is important. Service should allow for handling of large and small equipment and storage of materials. Access to the service areas must be straightforward and convenient.

CONCLUSION

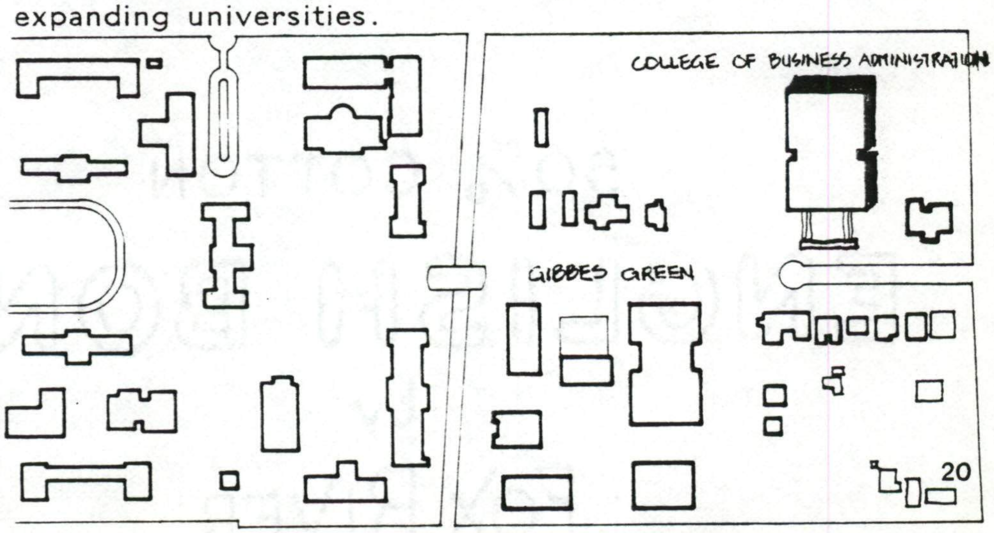
In conclusion, the different activities and user groups are obviously useful to one another if properly accessible and interrelated. Most important is a useful balance of theory and practical experience in education. The building users should be allowed to experience the whole of activity found in the College of Engineering. Activity relationships will be discussed in more detail in the building program.

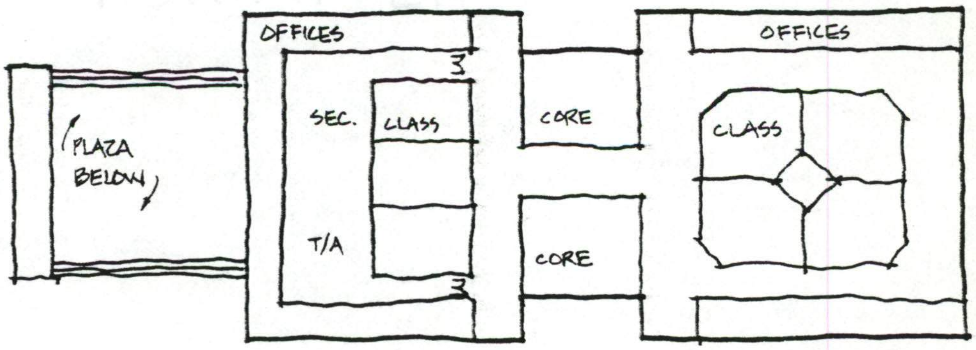
THE BUILDING TYPE

Building case studies serve as resources for information about the building type. Various case histories will give insight to the different levels of activities and needs that will be found at the University of South Carolina Engineering Center. The method of study will focus on the engineering center as a campus building and technical building.

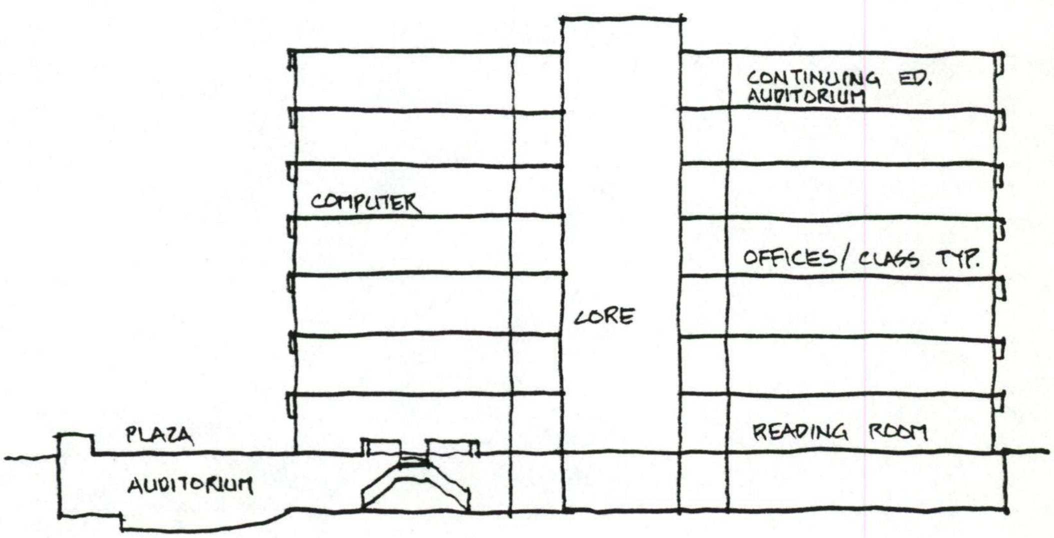
THE CAMPUS BUILDING

The College of Business Administration at the University of South Carolina is a good example of a campus oriented educational facility. Built in 1973 and expanded in 1983, the nine level facility contains over 300,000 square feet of administrative and faculty offices, A/V classrooms, auditoriums, continuing education facilities, computer facilities, ETV facilities, graduate areas, and a library. Designed by GMK of Columbia, the building holds an SCAIA Honor Award and is the subject of study by other expanding universities.

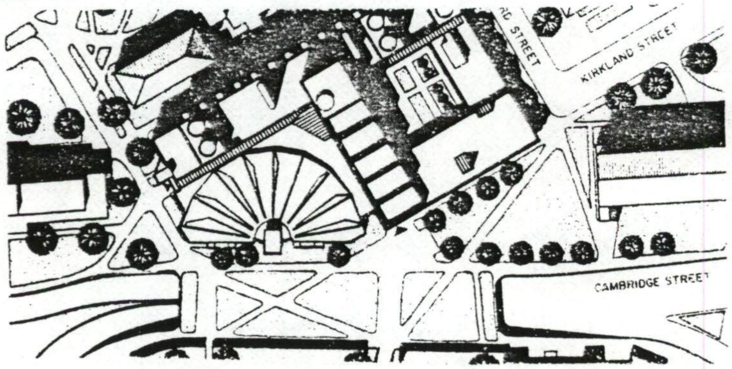




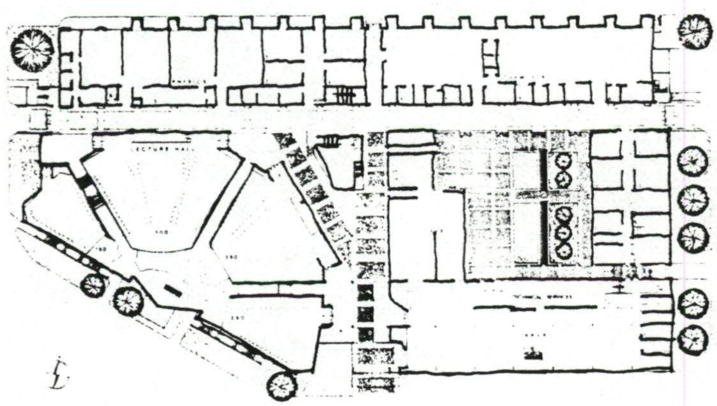
The building solves the problems of clear circulation often associated with large campus buildings. The entry is formed by a plaza off of Gibbes Green, a restructured campus area east of the Horseshoe. A common space is formed at the entry, flanked by administrative offices to one side and counseling offices on the other. The full level on the backside of the core area is devoted to student study space. A grand stair opens to the underground level containing an auditorium and student lounge areas. Major corridors run parallel on each side of the core and provide direct access to major areas. A secondary circulation path provides access to perimeter offices, open plan secretarial areas, and graduate areas.



The Undegraduate Science Center at Harvard University responds to suggestions made by faculty members that interest in the sciences could be strengthened through the close proximity of various disciplines. Designed by JL Sert and Jackson Associates, pedestrian streets are pulled inside the building to form a spine of activity linking the north and south campuses of the university. This not only promotes interaction within the building, but creates interaction with others on campus as students meet in the interior street. The visitor, along his route, sees the science student working, therefore broadening his views of the field.

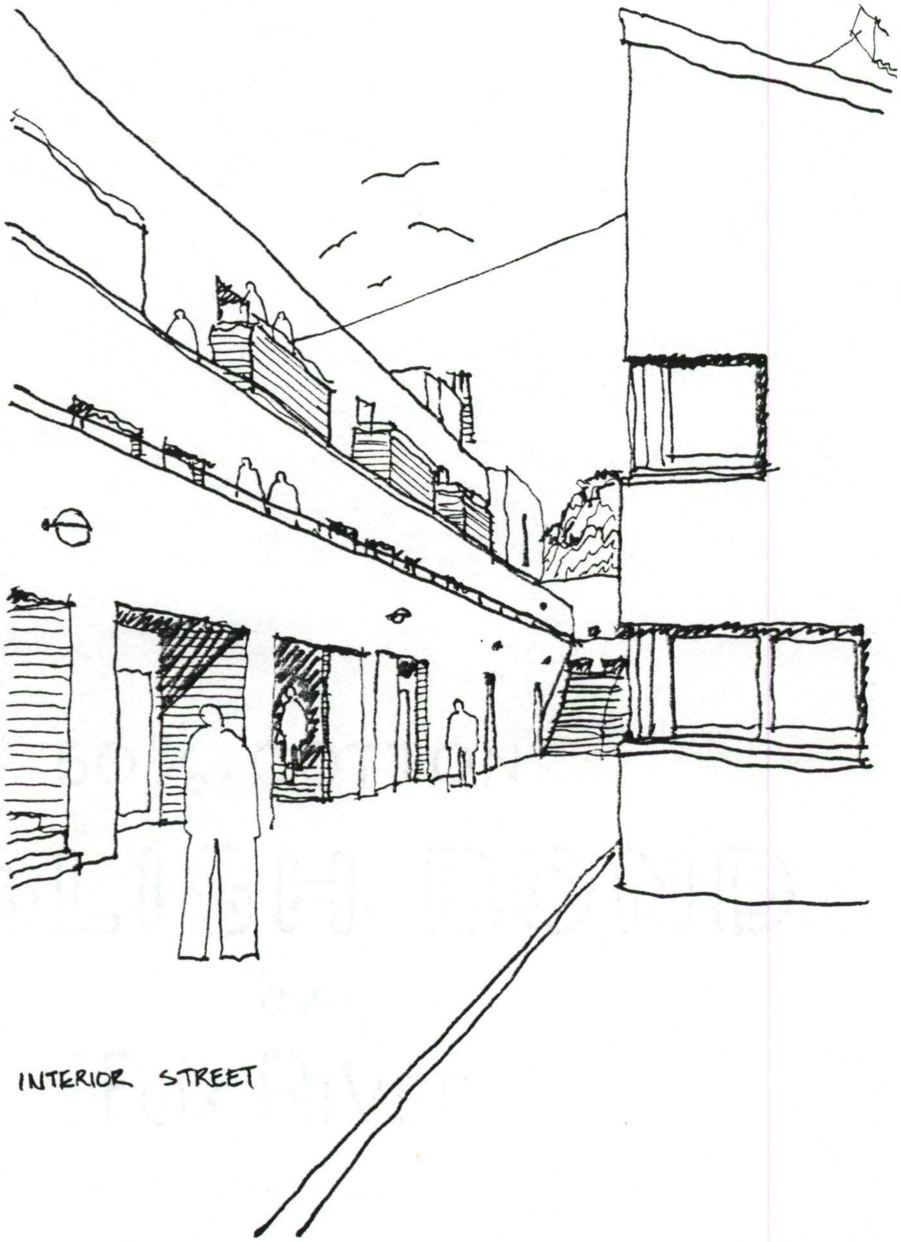


Paralleling the street on one side are laboratory areas. This clearly puts the laboratory within reach of the student. A "T" intersection off the main street links the building with a green space. Auditoriums and offices flank this secondary street and a focus is formed where all the common spaces come together.



Clear circulation is an important concept of this building also. A central stair and elevator core found at the intersection of the streets makes all areas of the building accessible from this point. At the upper levels, the "T" forms the space for classrooms and offices, thereby creating a physical link between classrooms and labs. This reinforces the concept of relating the classroom and lab in scientific or engineering education.

Robinson College at Cambridge University, England, is a collection of buildings responding to open green spaces and interior courts. The complex, built in 1980, was designed by Gillespe, Coia, and Kidd and received a RIBA award, in 1981. The building forms a well scaled edge on Grange Road and opens to an interior street that parallels the road. A series of balconies front the interior street to encourage student interaction. The east side of the College opens to a field in a manner similar to other Cambridge colleges.

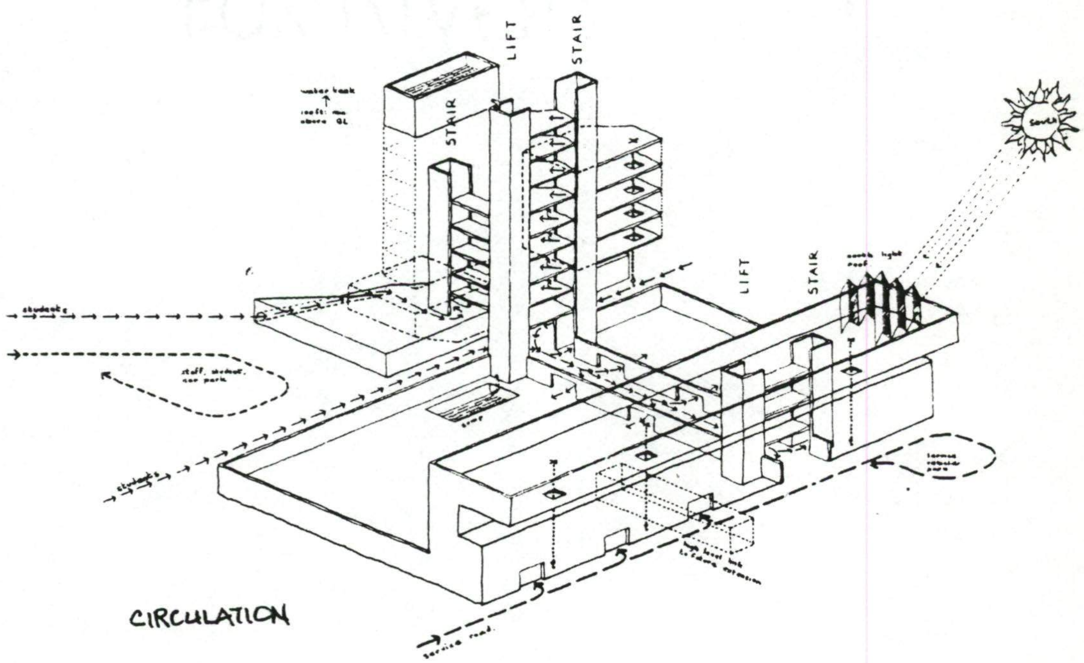


INTERIOR STREET

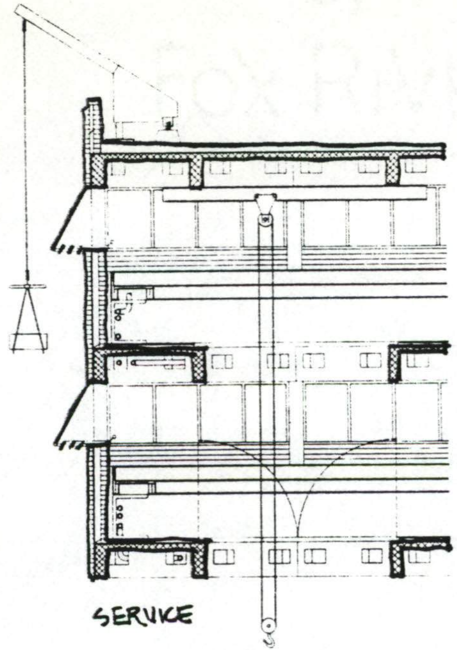
THE TECHNICAL BUILDING

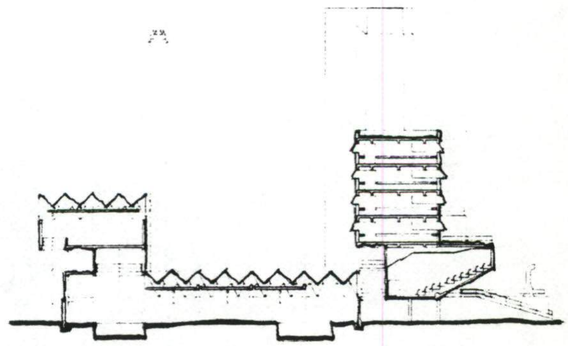
Understanding the technical aspects of an engineering building is important. System and equipment demands are greater for this building type than most others. Engineering lab types range from heavy equpment process and testing labs to light equipment research labs.

James Stirling's Leicester University Engineering Building had to respond to a very tight site. The technological aspects are very important in this respect for it solves the problems associated with multi-story labs and structure. Stirling separates the activities of the office, classroom, heavy equipment labs, and light equipment labs. Major ground related labs take priority on the lower levels while classrooms and other labs are zoned in the middle levels. Offices are located at the uppermost level for they are a low activity function and can be reached with a lesser number of elevators. A central circulation core is maintained to connect all the spaces.



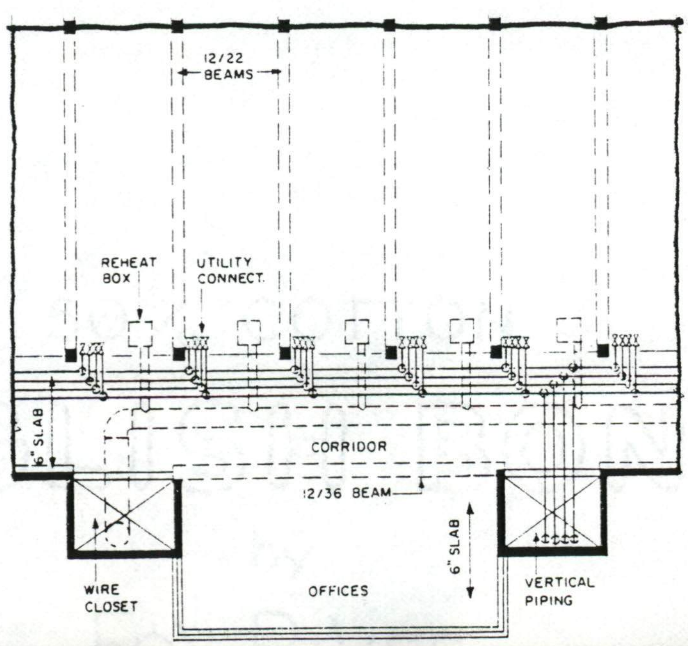
CIRCULATION



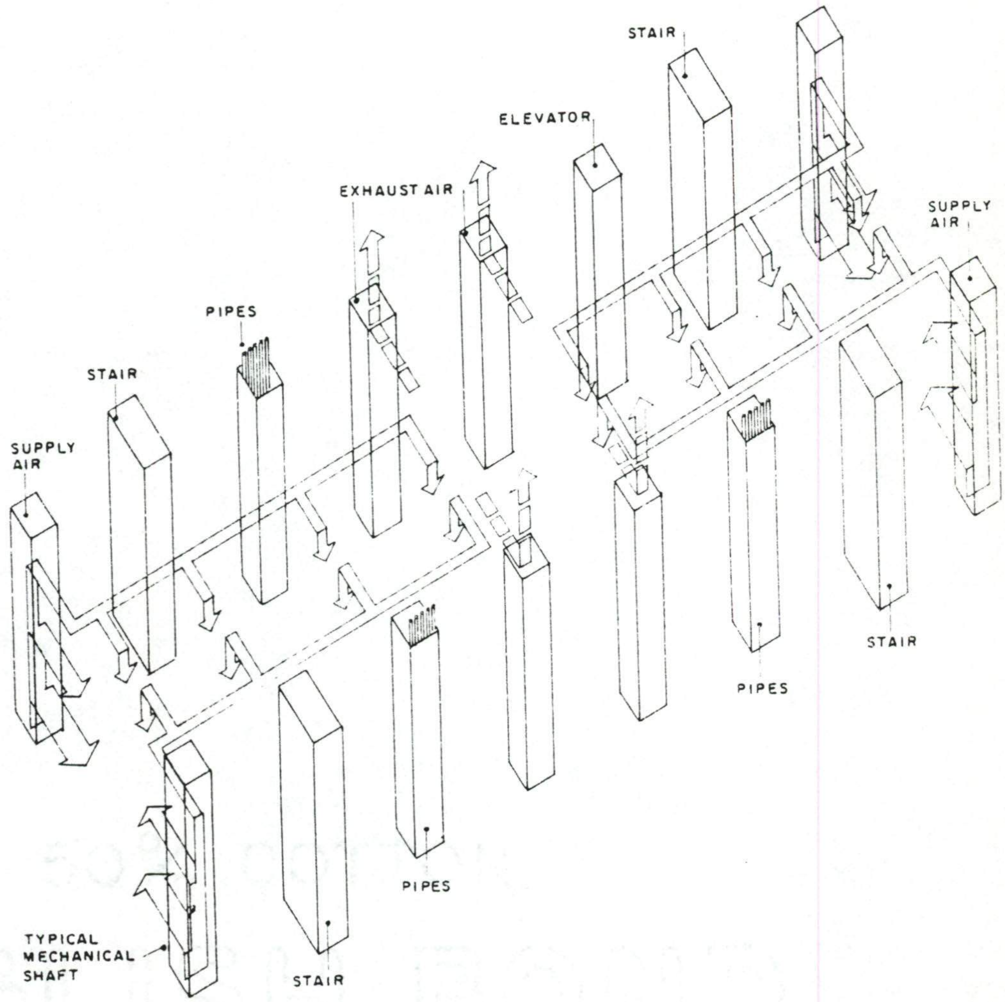


The separation of activities between the heavy equipment labs and classrooms and offices allow structural separation because of different load demands. Multi-level labs are made possible here by the use of floor openings and hoists. This allows for flexible vertical and horizontal movement of equipment and materials not found with the application of freight elevators. The stuctural capabilities of concrete slabs and deep joists allow multi-level workshop areas. System distribution is through large vertical chases and is exposed in the horizontal runs. A 'High Tech' image is conveyed through innovative use of structural tile, exposed steel and concrete, and exposed systems.

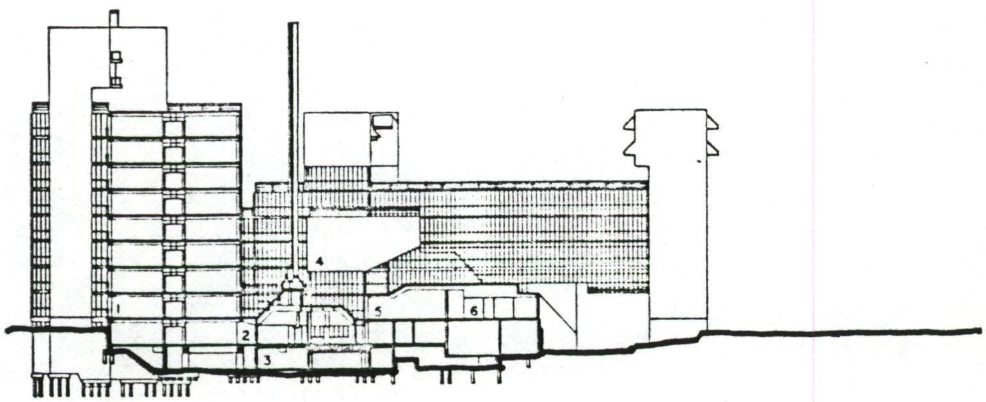
The Butler University Science Center, by Hellmuth, Obata, and Kassabaum, uses a poured in place concrete frame that eliminates structural impediments in corridors and labs and frees space for ducts over entire floor areas. Flexibility of lab arrangements was important, so HOK used vertical system chases at the perimeter of the building. The structure is poured in place concrete with 12" x 22" joists and a 6" slab. The 10' x 30' bay works with a lab module and provides lateral stability.

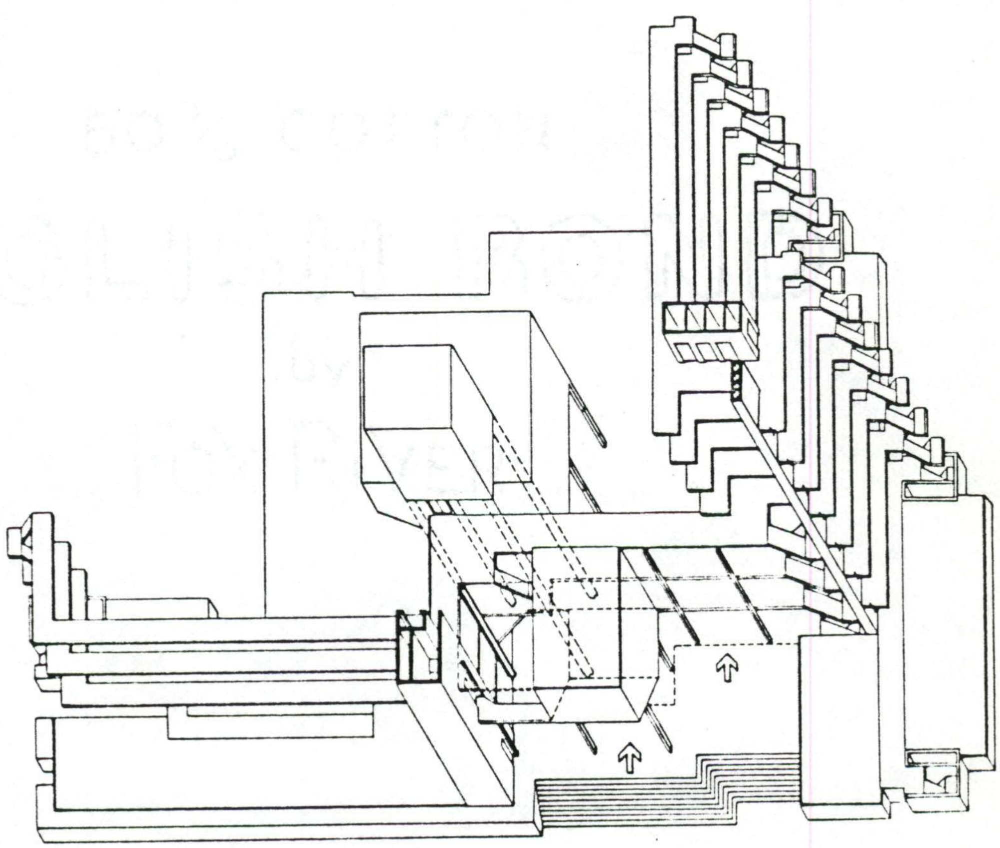


As mentioned, systems are supplied at the perimeter of the building. Chases are designated for either supply air and exaust air, piped and wired utilities, or circulation. Utilities are brought horizontally overhead, repeated at each ten foot module, and dropped into the lab at any desired point. The flat slab system is critical for it provides fire safety, rigidity, and keeps the plenum space at a maximum for the systems. Laboratories using these type systems can freely change with technology because the floor area is structurally free.



The Polytechnic of London, College of Engineering, responds to a very difficult site. Designed by Lyons, Israel, and Ellis, this building has similar laboratory requirements as the University of South Carolina's College of Engineering. Of particular importance is the vertical zoning of laboratory space. Heavy equipment areas occur on ground levels, while classrooms, offices, and specialized labs are interrelated on the upper levels.

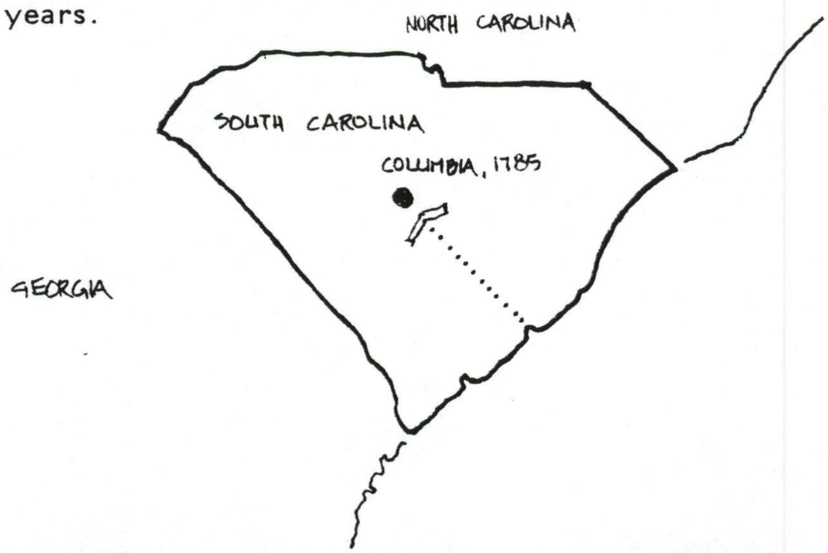




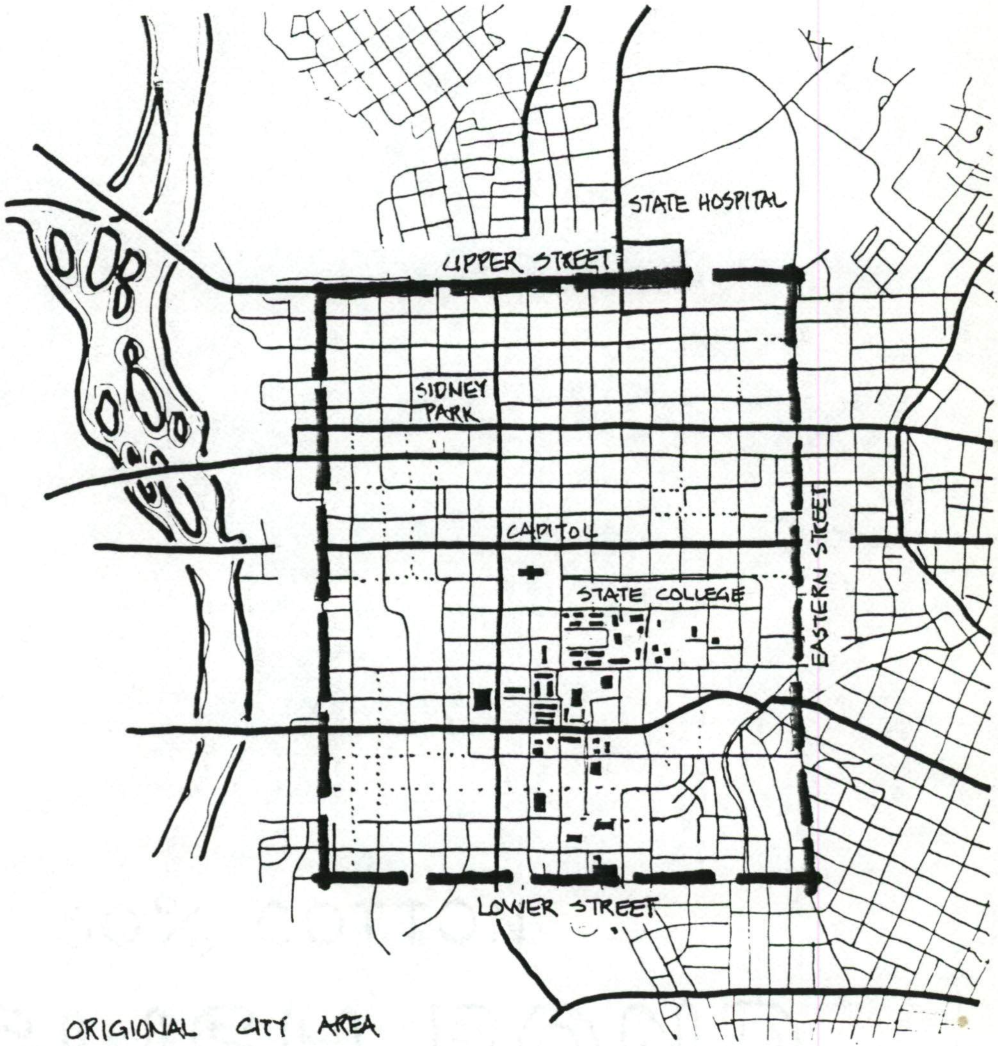
SETTING: THE CITY AND UNIVERSITY

COLUMBIA

The city of Columbia was founded in 1785 by an act of the State Legislature. Located halfway between Charleston and the Piedmont region, the new capital centralized the governing body and made the city accessible to all citizens of the state. Originally agricultural lands, the city soon attracted merchantile businesses, trade, and other amenities to support the settlement. The city remained prosperous and various institutions were formed to provide the city with supporting facilities to strengthen the city and state. The South Carolina College was founded in 1801, and the State Hospital in 1828. In 1864, Columbia saw its biggest setback when General Sherman ordered the burning of the city. The Union Army occupied the buildings of the South Carolina College campus and fortunately were spared destruction. Growth of the City during Reconstruction was slow, yet by the 1890s, public services and utilities included street cars, telephone and electric service, and a waste disposal system. City growth during the first half of this century remained steady, with a surge in both suburban expansion and downtown development in recent years.

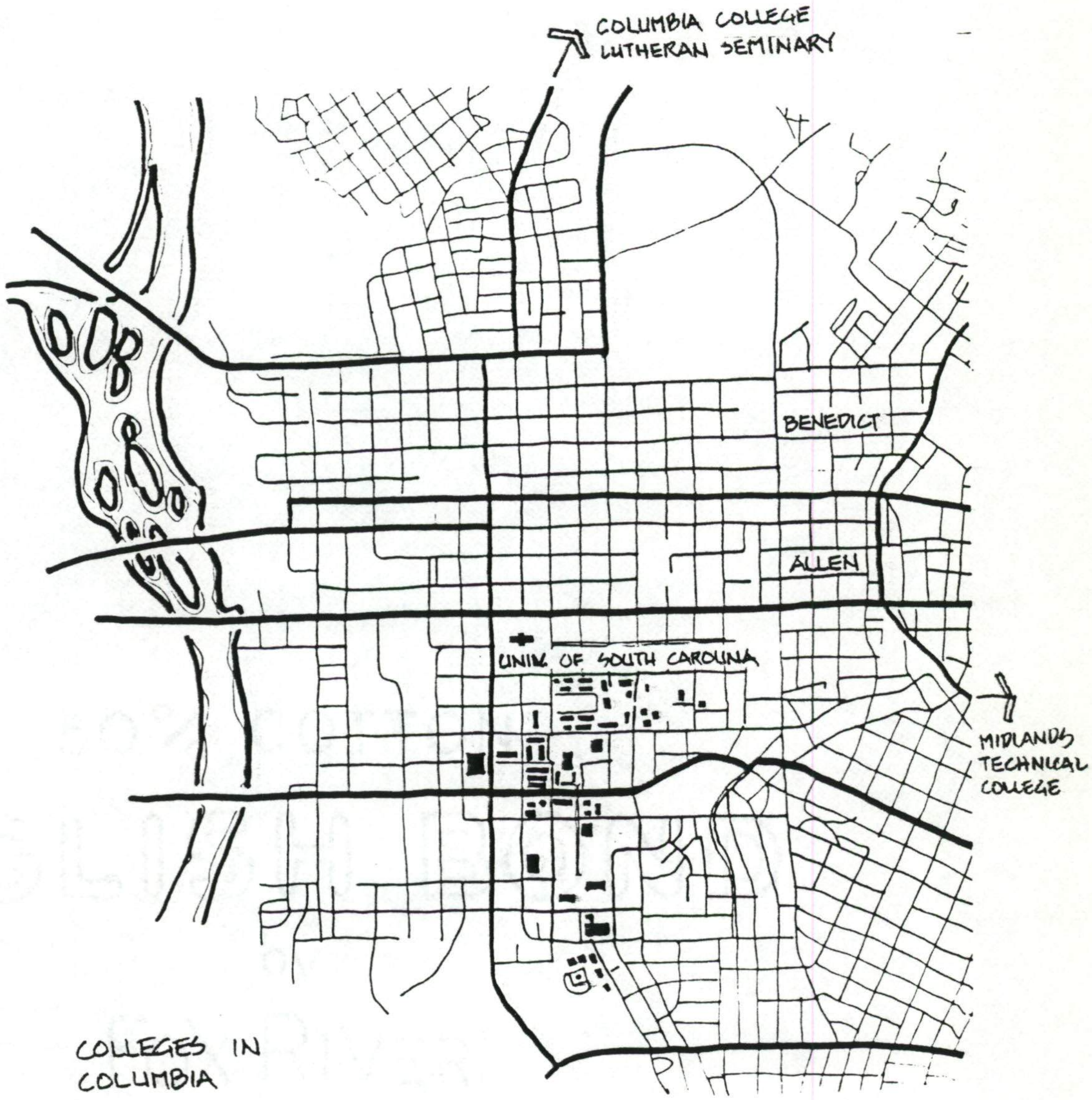


Columbia was one of the earliest planned cities in the United States. A two-mile square was designated as the new capital. Columbia was bounded by an Upper Street (now Elmwood), a Lower Street (now Heyward), and an eastern street (Harden). These streets and the central streets (Senate and Assembly) were 150 feet in width. Other streets in the city were 100 feet wide. Within this gridiron development, various developments broke the grid of the new city. The Capitol Building, Sidney Park, and the campus of the South Carolina College were these exceptions.



ORIGIONAL CITY AREA

In recent years many businesses, agencies, and institutions have devloped or located in Columbia. The city's original intent of providing a centralized capital has proved to be advantageous for institutions and employers in the state. Columbia has become the home of seven institutions of higher education. Serving the needs of the state, Allen University, Bennedict College, Columbia College, the Lutheran Seminary, Midlands Technical College, and the University of South Carolina have all chosen Columbia sites for their campuses. Businesses and industries located in the city look to these universities as resources.

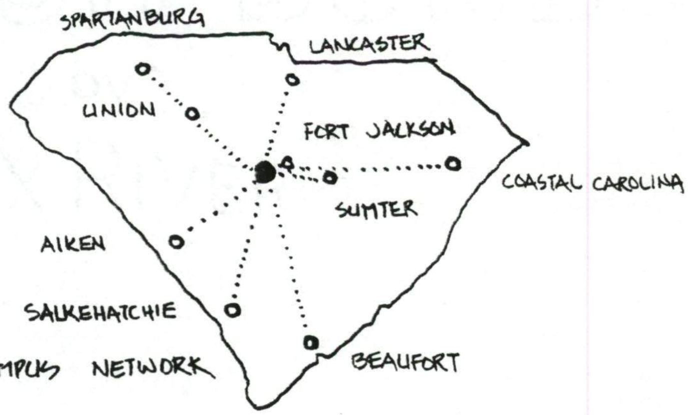


COLLEGES IN
COLUMBIA

UNIVERSITY DEVELOPMENT

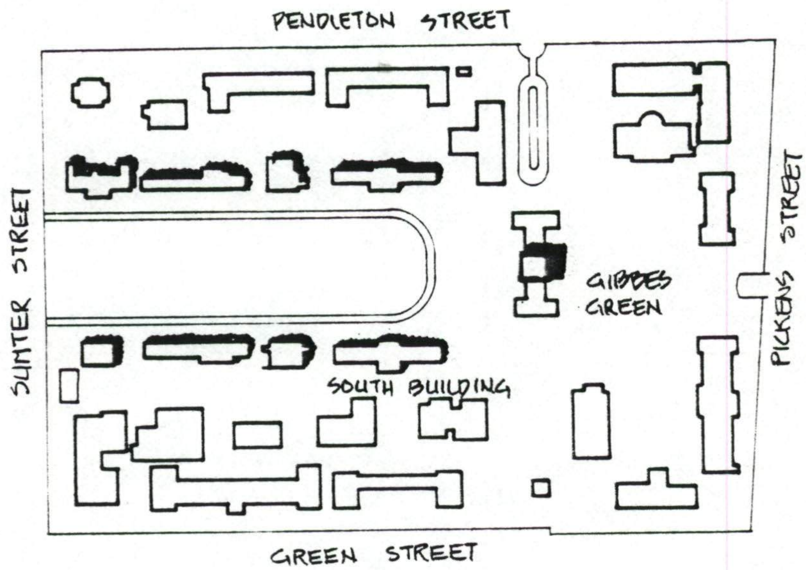
The University of South Carolina was chartered in 1801 as the South Carolina College. USC, among the oldest of state universities, held a national reputation for academic excellence in the classical tradition in the years before the Civil War. In 1862, the College closed when the student body volunteered for service in the Confederate Army. Re-opening in 1865, the institution went through six reorganizations in the last decades of the nineteenth century. The Depression and two World Wars caused little growth at the university.

Contrasting an ante bellum policy that the South Carolina College produce scholars rather than professionals, the University's current policy was established, in 1925, to furnish both liberal and professional education to all people of South Carolina. After World War II, the University began its renaissance. There are now colleges of Business Administration, Criminal Justice, Education, Engineering, Health, Journalism, Law, Librarianship, Medicine, Nursing, Pharmacy, Humanities and Social Sciences, and Science and Mathematics. The University expands its promise to further higher education in South Carolina through an extensive nine campus network, whose hub is in Columbia. A comprehensive communications network connects the Columbia campus with regional campuses, thereby utilizing all university resources. The University of South Carolina is dedicated to the development of a quality physical university system that will serve the needs of South Carolina.

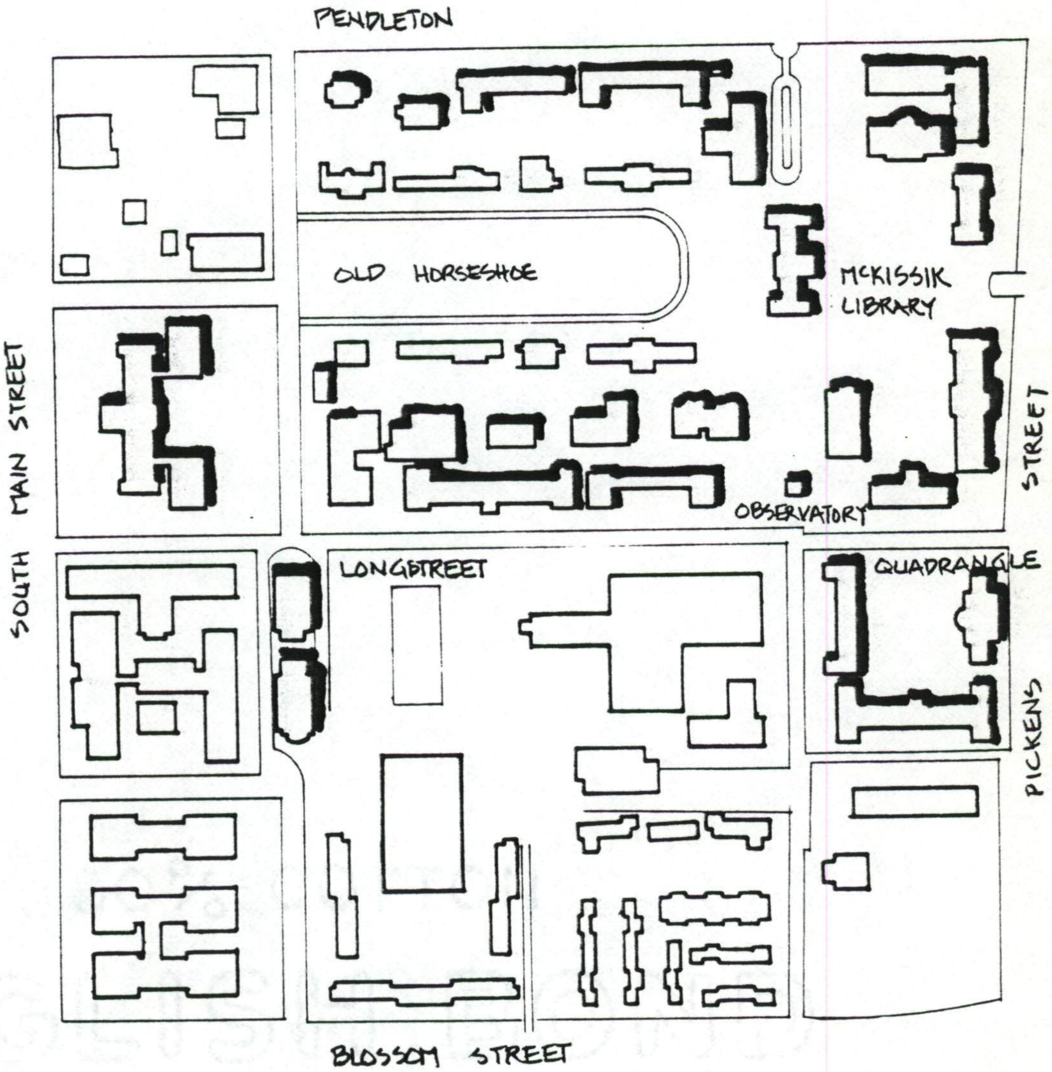


REGIONAL CAMPUS NETWORK

The original location considered for the South Carolina College was at the southern edge of the city near the Rocky Branch, but the idea was abandoned for a more central location in the city. The trustees decided upon land immediately to the southeast of the new capitol building. The tract was composed of seven city blocks, and there was concern as to whether the seventh block, towards Blossom Street, was useful because of the steepness of grade. As planned, the College was given permission by the city to close off all streets bisecting the property. A competition was held for the design of the first building. The commission was divided among two architects one of which was Robert Mills, who later oversaw the design of the campus. The original intent to build one structure was abandoned for a symmetrical arrangement of buildings to house fifty students each. The first campus building, the South Building, was completed by 1803. Growth occured quickly and by 1850 the main campus was completed. Two rows of buildings fronted the lawn, which gently sloped upwards on an axis, and terminated at the president's house. A garden on the back side of the president's house was known as Gibbes Green, and was expanded another three blocks in 1833. This old part of campus was surrounded by an ivy covered wall that was designed to contain students that often found themselves engaging in cockfighting, trouble at the river docks, and other mischief. Later, though the old wall remained, a double gate was added and the horseshoe shaped drive was introduced.



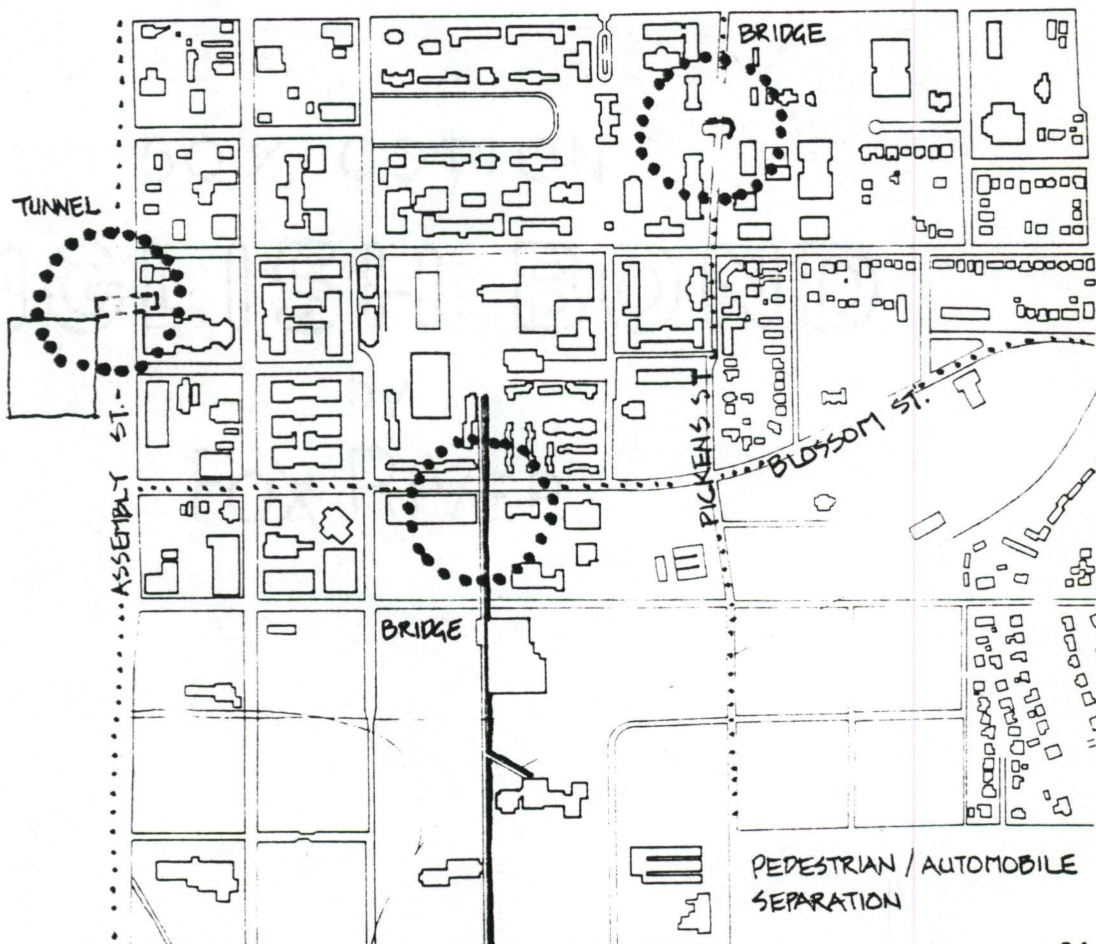
In the second half of the nineteenth century, the College had outgrown its original area. Growth jumped Green Street with the building of Longstreet Theatre in 1855. The fields across Green Street saw a variety of uses from athletic and agricultural areas to parade and drill grounds for Federal troops. By the 1900s, this area was under futher development, and the women's dormitory quadrangle was underway by 1924. In 1940, a revival style library was built on the site of the old president's home, thus giving a more prominent landmark to the end of the Horseshoe. Still, the campus was avoiding the steep area towards Blossom Street that the original trustees had been concerned about.

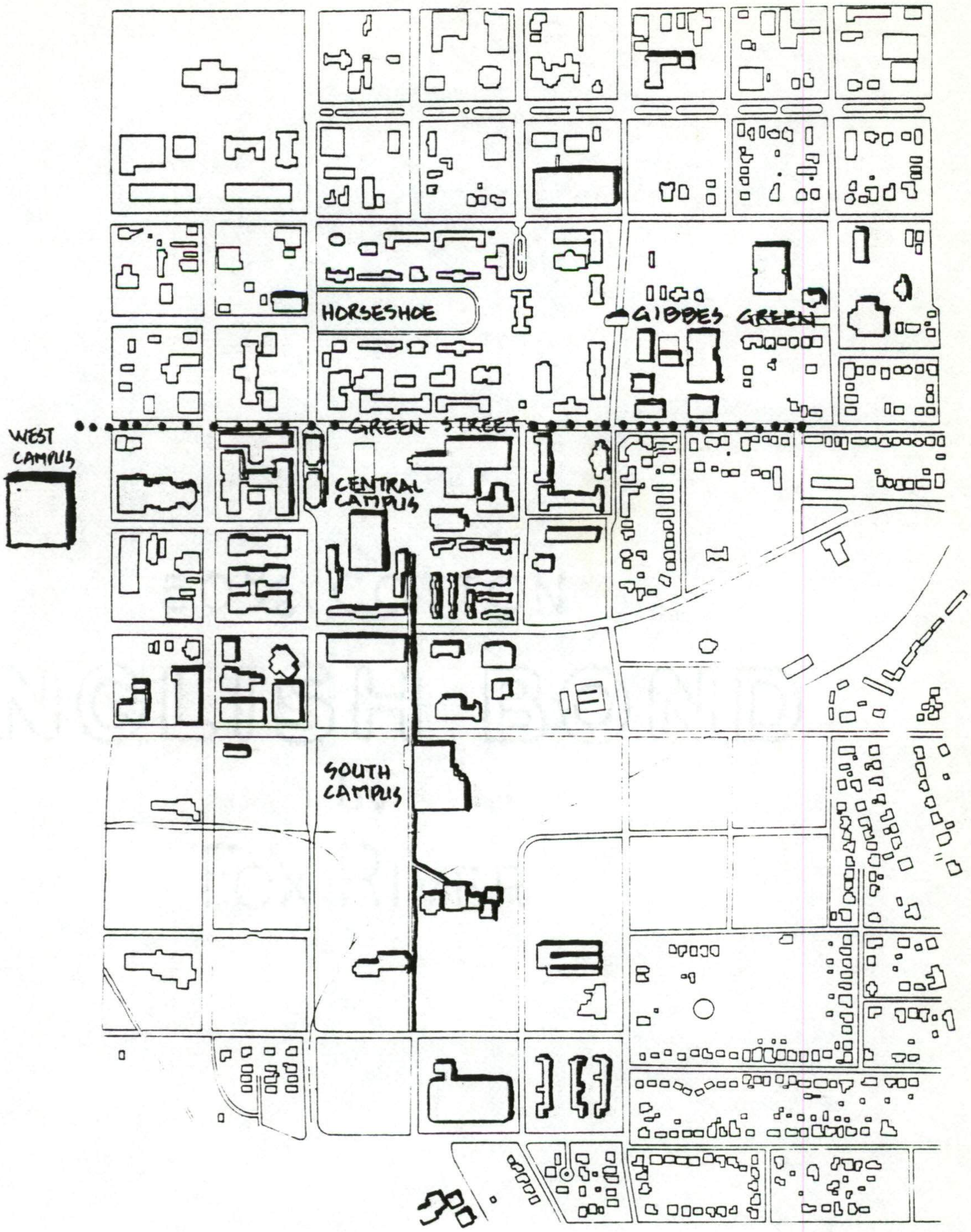


GROWTH: 1870-1940

After World War II, the University's growth has been continuous. It was about this time that the University abandonded its common aesthetic of stucco. The present engineering school was built as was the first phase of the Cooper Library. In the 1970s, Gibbes Green was developed to house a business school, a nursing school, and humanities buildings. A pedestrian bridge was built to cross Pickens Street to this area. Many dormitories were also built at this time.

After development had balanced on both sides of Green Street, the University began to realize the problems associated with being an urban university. Many studies were made for the closing of Green Street, but officials concluded the street should be closed only during school hours. Another pedestrian bridge crosses Blossom Street to more dormitory areas on the South Campus. This campus to the south is comprised of dormitories, athletic fields, and a college of health and physical education. Campus growth is expected to continue in this area. A tunnel connects the law school with the coliseum and journalism school in the West Campus area. This western portion of campus is closely connected to the Central Campus along what is considered the Green Street Spine and includes the buildings associated with the sciences.





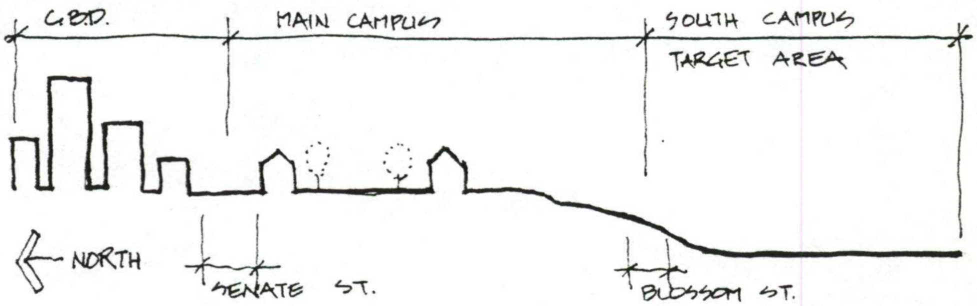
GROWTH: 1950s - PRESENT

GROWTH TRENDS

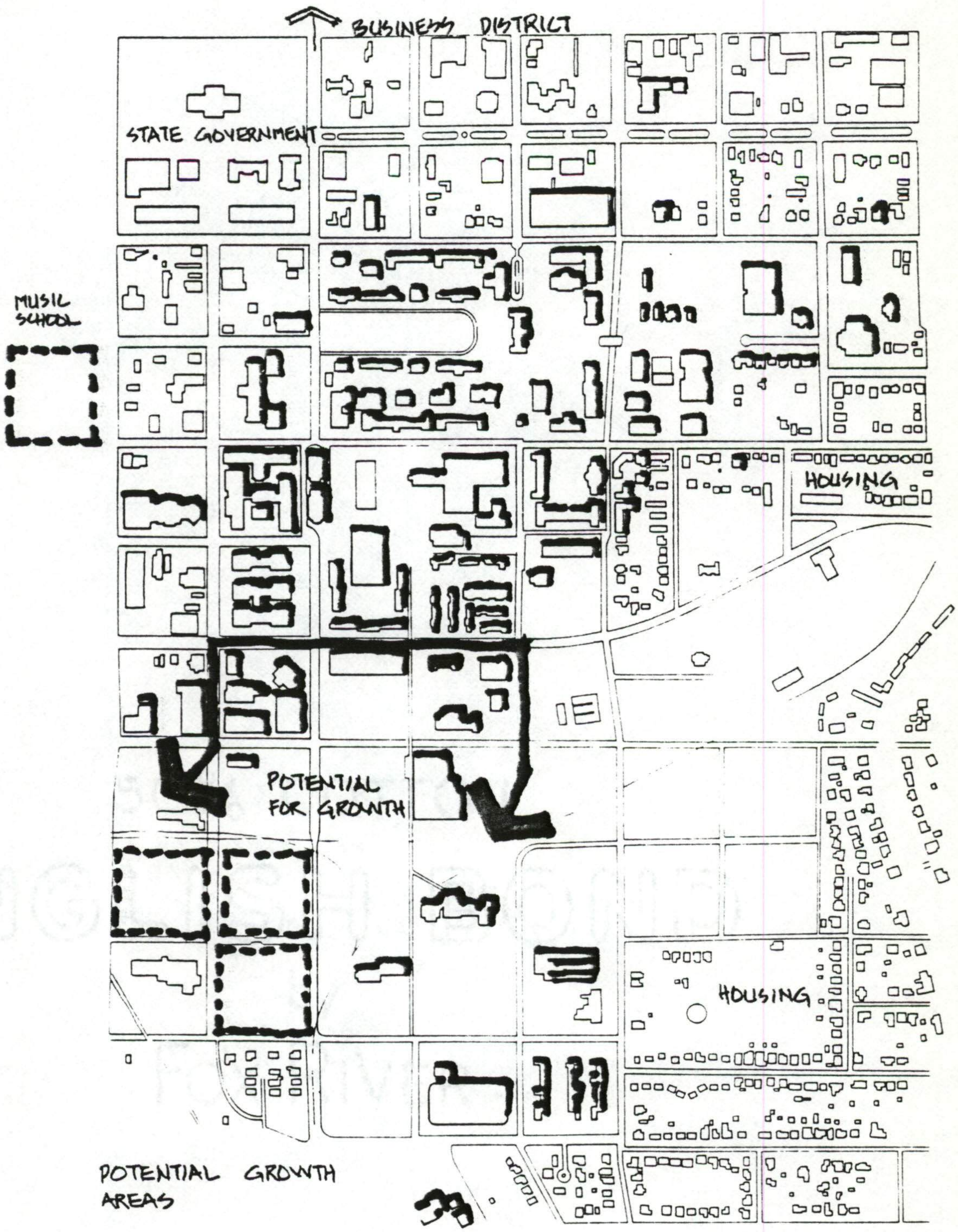
The nine-campus network is becoming a major asset of the University with the advent of communications technology. With this network, it is expected that the Columbia campus enrollments will begin to taper off as the quality of education increases. The University of South Carolina has seen its enrollment growth parallel a growth of quality physical facilities.

There are still some physical expansions under consideration at the University. A new auditorium will be built in the west campus along the Green Street Spine, and development will end in that area after the completion of a new music school. With the move of the College of Engineering into new facilities, the Department of Math Sciences will occupy the retrofitted engineering building.

The University has found itself in difficult situations in the midst of a city with high land values and hard to obtain land. USC has therefore been committed to the use of existing facilities whenever possible. The city structure has prohibited growth to the north because of the Central Business District, to the east because of housing and merchantile development, and to the west because of business. The south area of campus is thus the target area for further growth of the University. Development of the South Campus has been possible because of adaptive reuse and urban renewal grants.



USC's planning concept is to evaluate existing situations on campus at each point of growth. Buildings do not have to follow any aesthetic guidelines in terms of materials, but they must follow patterns of landscape and scale in the project area. In its commitment to quality design, the University and its architects have won two recent SCAIA Honor Awards; one for the College of Business Administration and the other for the restoration and reuse of the historic Horseshoe. If this trend in quality is not sacrificed, the USC campus fabric should develop in a positive manner.



BUSINESS DISTRICT
STATE GOVERNMENT
MUSIC SCHOOL
HOUSING
POTENTIAL FOR GROWTH
HOUSING
POTENTIAL GROWTH AREAS

ENVIRONMENT

The natural environment is important when considering the physical setting of the project area. Columbia is built between the two physiographic regions of the Piedmont Plateau and the Atlantic Coastal Plain. The plateau of the city averages 300 feet above sea level and this plateau slopes downward, west to the river and south just beyond the main campus of USC. The geology underlying the campus consists of coastal plain sediments lying in an irregular bed of granite. The sediment thickness varies from zero to 150 feet, depending on the underlying granite, and has been determined to have a high potential for urban development. The campus has a great deal of vegetation primarily found in the form of formally planted oak trees along road edges.

The climate consists of hot, humid summers and moderately cold winters. The typical summer has about six days of 100 degree temperature and is the rainiest season with 33 percent of the total rainfall. Fall is a mild season with a minimum of rainfall. Winters extend from November to mid-March with one third of the days having minimum temperatures just below freezing. The annual average percipitation is 41.5 inches. The prevailing winds are from the southwest at an average speed of 6.3 miles per hour.

CAMPUS IMAGE

In order to understand the physical makeup and perception of the campus, an analysis as set forth by Kevin Lynch in IMAGE OF THE CITY was undertaken. The university can be seen at two levels: one being the campus within the city and the other being the image of the campus itself. This analysis uses the same concepts that Lynch proposes in naming the elements of the city character: edge, path, district, node, and landmark. The district perceived by city dwellers of the university is that area of the Horseshoe, Gibbes Green, Central Campus, and part of the West Campus. This area is bounded by Pendleton Street to the north, Blossom Street to the south. Vague edges are Assembly and Main to the west, and College Street to the east. Most passersby recognize the South Campus area but tend to be unsure of its role in the overall campus. Major paths are the roads around and through campus. Generally, pedestrian areas are not perceived. These major paths include Green Street, Sumter, and Pickens. Landmarks identifying the university include the Horseshoe, Longstreet Theatre, the library, and the Capstone House. The areas of activity most noted from the city are around the student center and along Green Street.

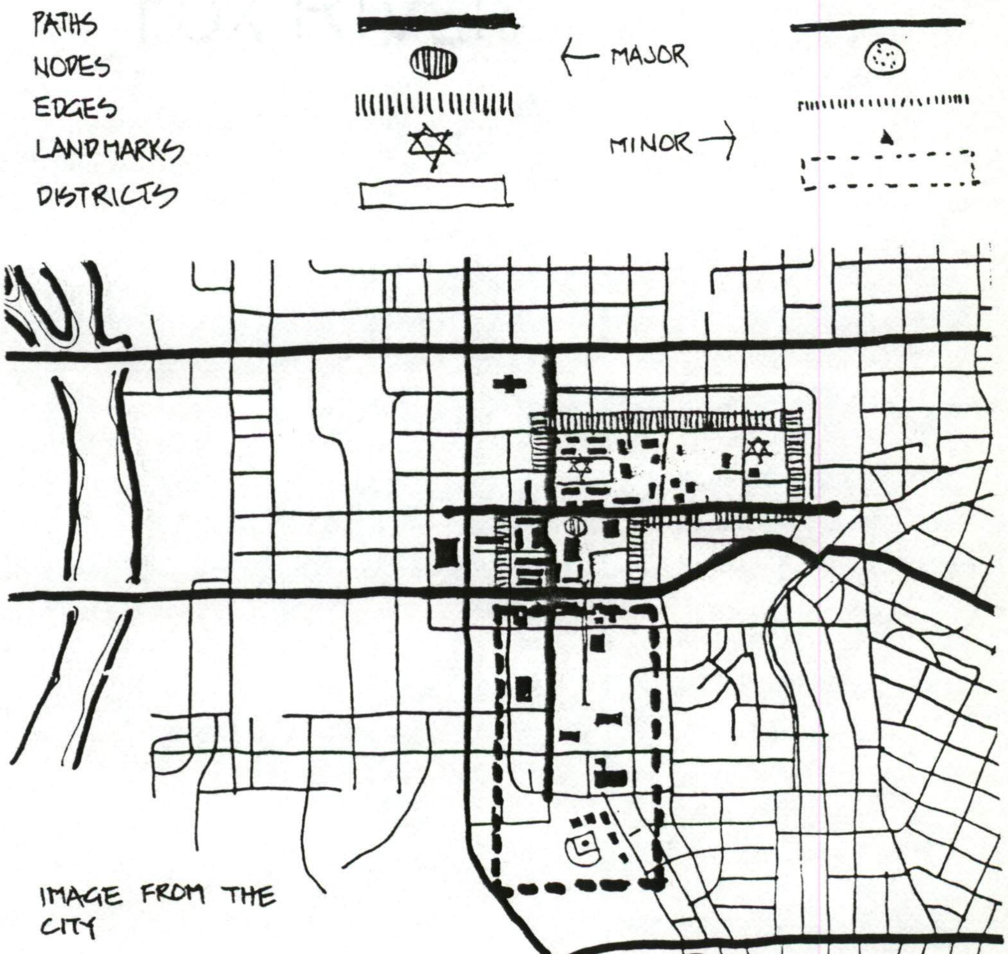
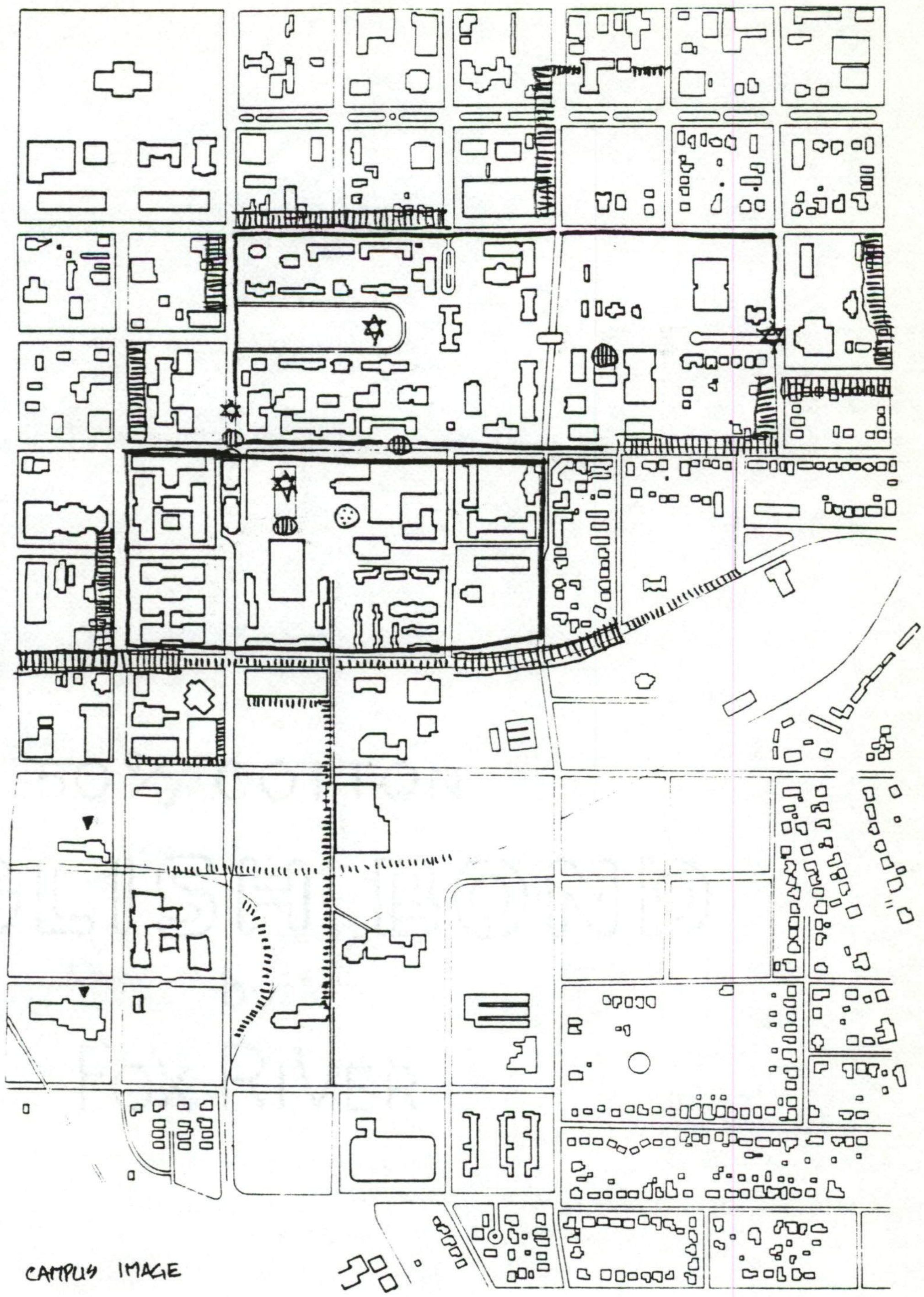


IMAGE FROM THE CITY

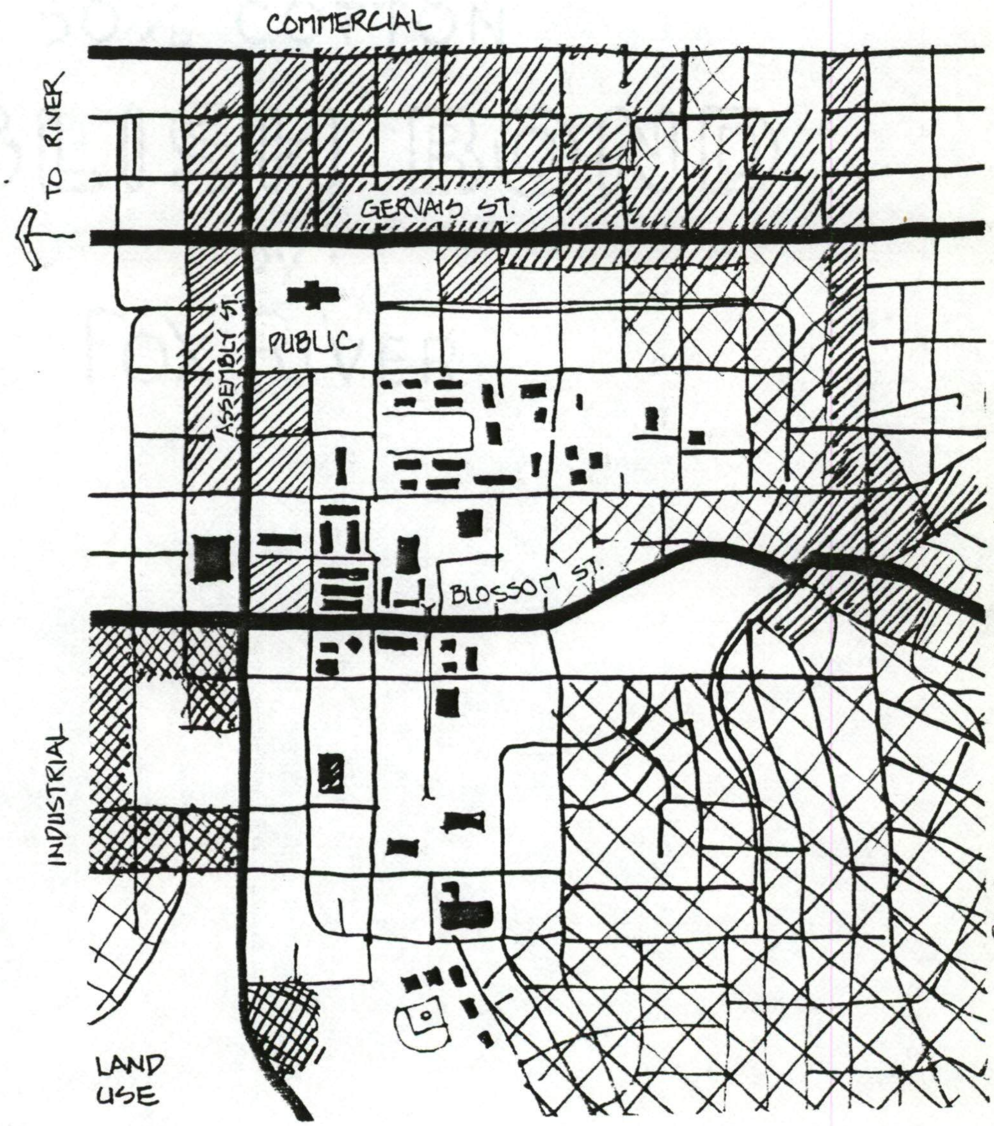
A different image of the USC campus is perceived by the pedestrian. This image is often unknown to the casual city observer because most paths and nodes occur within the districts away from traffic paths. Major edges are similar to those defining the overall campus district and can be seen more accurately on the following map. Most paths occur internally on the city blocks. Major paths occur along Gibbes Green, Green Street, in front of the library, and to the South Campus area. Activity nodes can be found at the intersection of paths and in front of grouped buildings. The major nodes occur near the library, along Green Street, and around the humanities buildings. The strongest district is that of the Horseshoe and Gibbes Green area. An equally strong district from the city side is that of the Central Campus, but it has relatively weak internal space definition. To the south, Blossom Street is a strong edge that keeps activity from crossing to the South Campus area. The South Campus district is comprised mainly of athletic fields and lacks the edges and activity nodes that are needed to define an active and defined district.



CAMPUS IMAGE

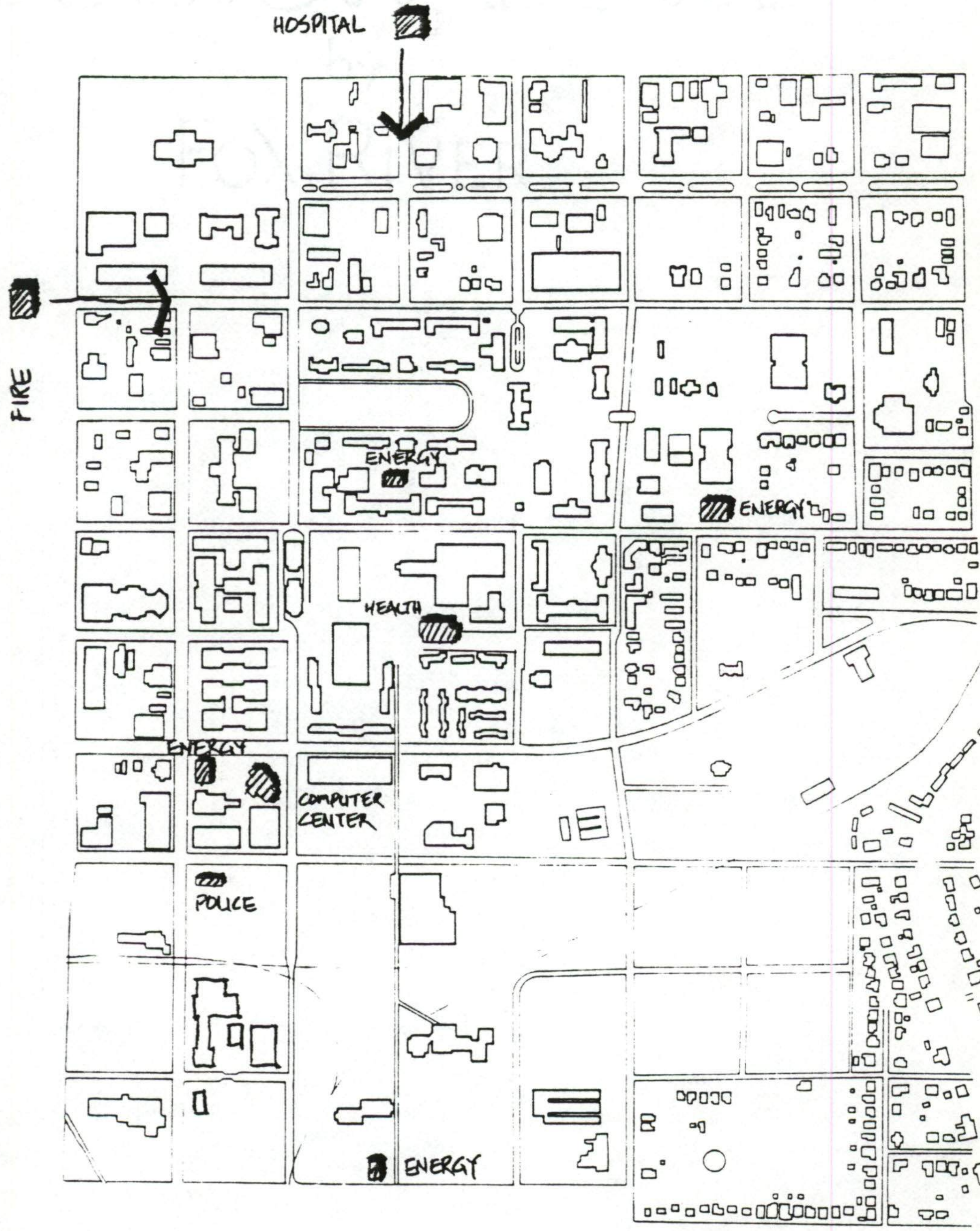
LAND USE

Neighbors of the University of South Carolina include a range of businesses and residential areas. Most of the small businesses and food establishments occur along South Main Street. To the north of Campus, state government and CBD areas occur. Two established neighborhoods, connected by the unique character of the Five Points merchantile district, are found east and southeast of the campus. South and southwest developments are sparse and consist of various industrial areas. Older neighborhoods left over from Columbia's textile mill era can be found in this area. In anticipation of university development, other establishments are locating in historic buildings adjacent to the South Campus.



SERVICES

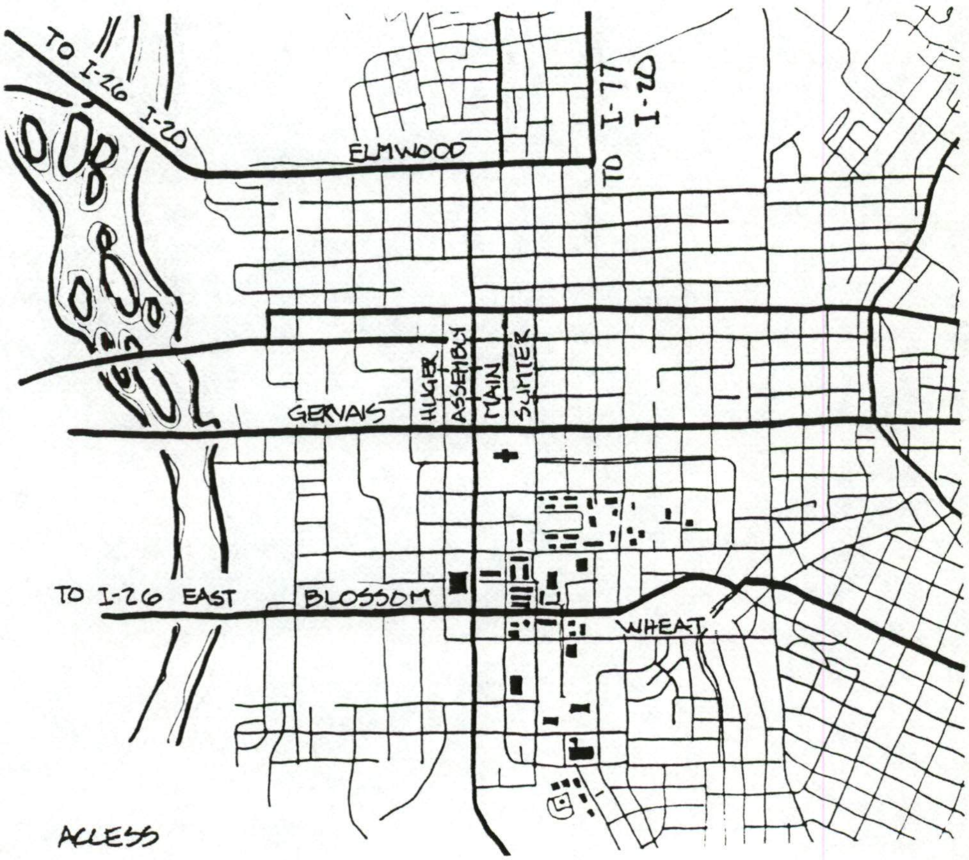
Services supplied for new development of the University come from internal resouces and the city. USC provides its own law enforcement and security patrol. Energy plants serve as electrical substations and supply steam and chilled water for the environmental systems of all university buildings. USC operates its own health infirmary which cooperates with the major hospitals in the area, the closest of which is the Baptist Medical Center on Taylor Street. The University also controls its own maintainence department for buildings and grounds. Communications operate on a separate Southern Bell exchange, while the computer system is owned and operated by the University.



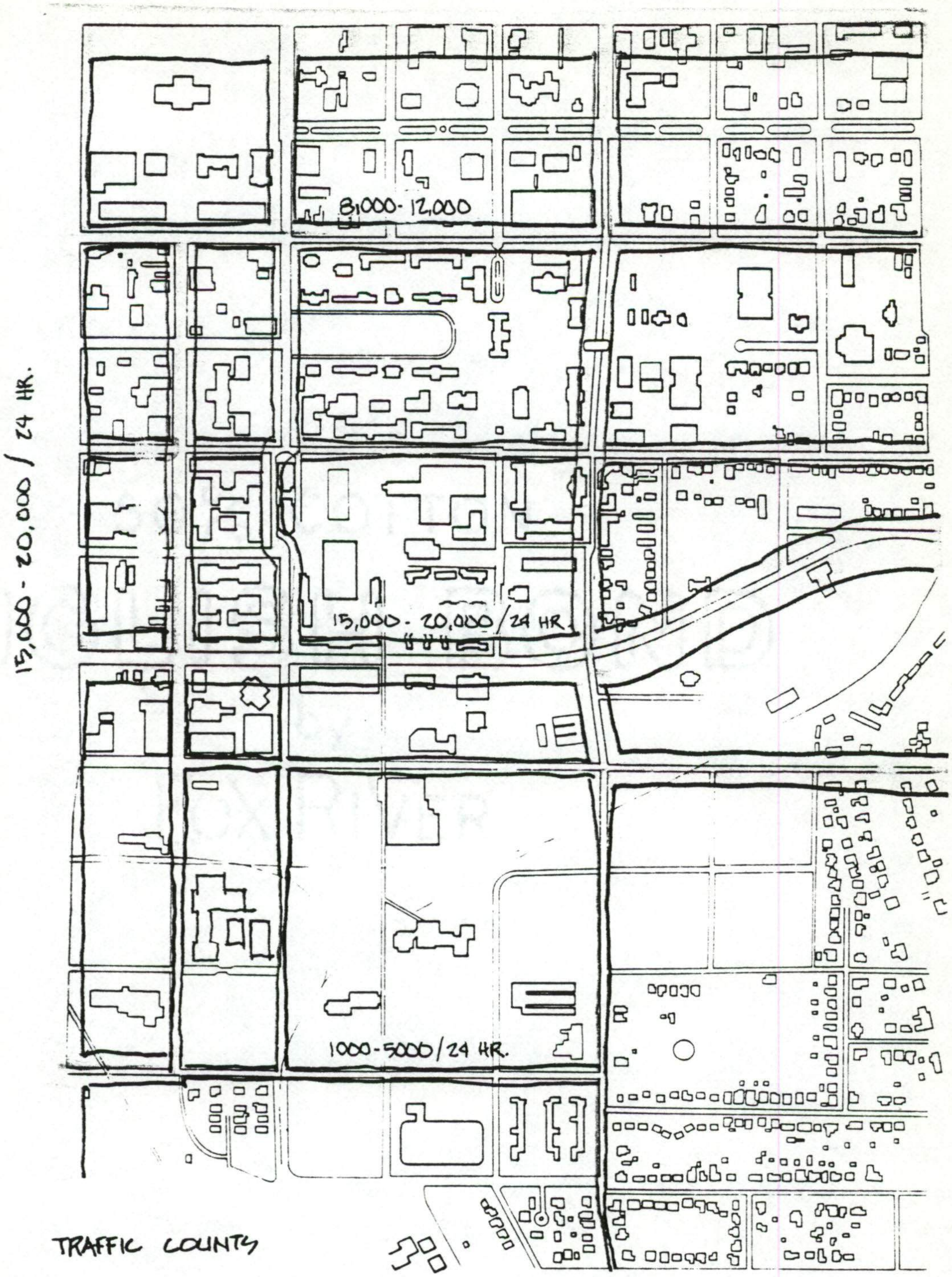
Various services are supplied by either the city or public service corporations. The City of Columbia provides the sewer service and sanitary landfill for the disposal of the University's waste. Electricity is provided by the South Carolina Electric and Gas Corporation to university substations. Fire protection for USC comes from the city's municipally based departments on Senate and Devine Streets. All services provided, whether by the University of South Carolina or by the City of Columbia, are adequate for the needs of the new College of Engineering.

TRAFFIC AND TRANSPORTATION

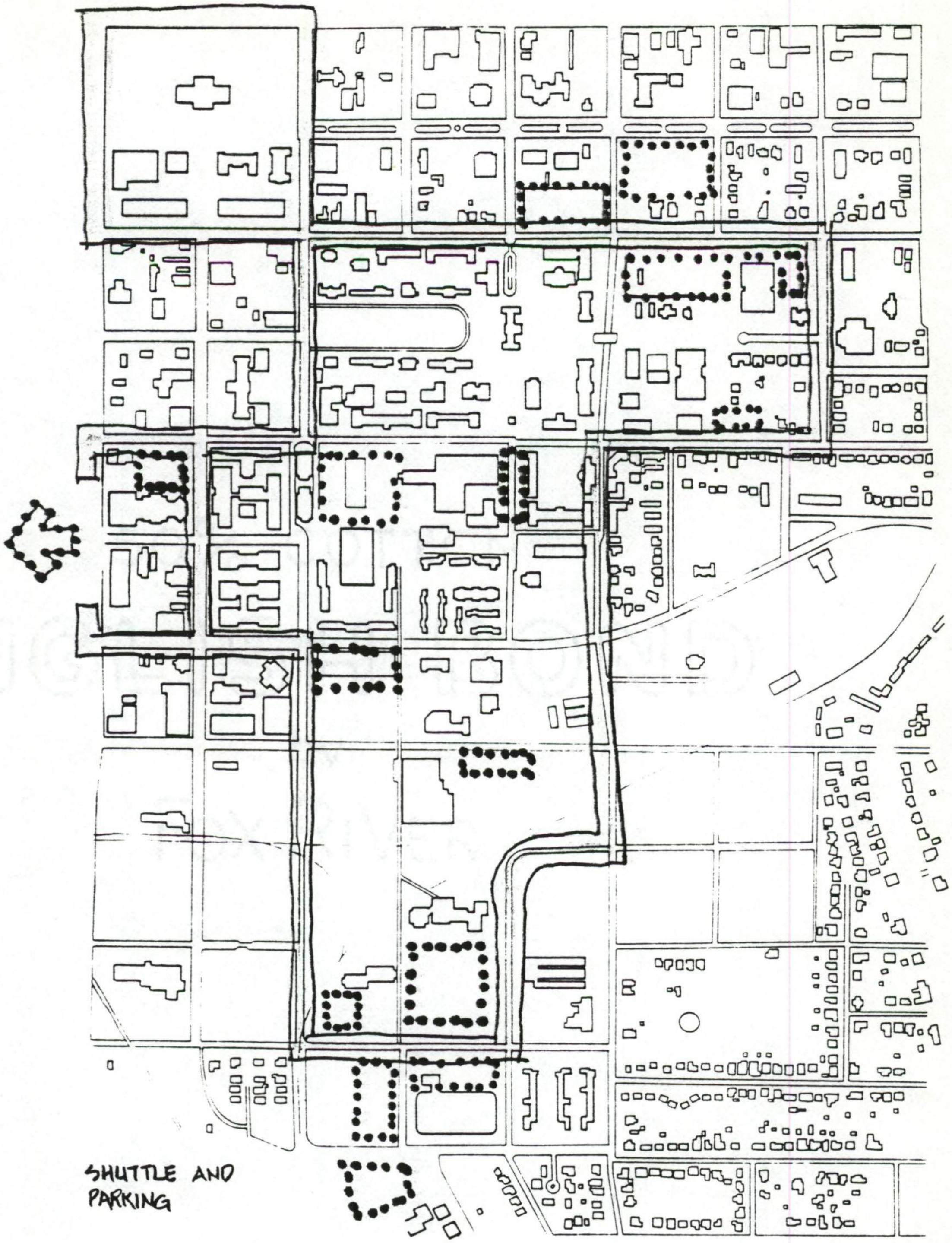
The major transportation networks of I-26, I-85, and I-77 carry traffic around Columbia. Interstate spurs and state highways bring traffic into the city. Major streets handling traffic to the University include Main, Huger, Assembly, and Sumter in the north-south direction. Elmwood, Gervais, Senate, Blossom, and Wheat Streets run in the east-west direction. The South Carolina Electric and Gas Corporation operates the public transportation system in the City. Average daily traffic counts in the area immediately around the University are shown on the map. The public bus service does not operate on the campus of USC.



ACCESS



TRAFFIC COUNTS


SHUTTLE AND
PARKING

USC operates its own traffic department. The University provides free parking for faculty, commuting students, and resident students. Two parking garages are located on the campus to provide rented spaces to students and a limited number of metered spaces. In the main campus area, all street parking is metered. The University provides a shuttle system known as the 'Shuttle-Cock' to transport students from perimeter lots to the center of campus. This full-time shuttle service is also used for transportation to distant parts of campus. Every attempt is made to separate pedestrian movement from automobile traffic. As mentioned earlier, the University uses a system of bridges and tunnels to achieve this.

CONCLUSION

It is apparent that the services provided by USC and the City of Columbia are capable of supporting a new college on the campus. The South Campus area should receive attention when planning further development of the University. The activity and campus image analysis should give insight to the response made in further development of this area. Historical information should also be considered in helping to maintain a sense of character and place at the University.

SITE SELECTION AND ANALYSIS

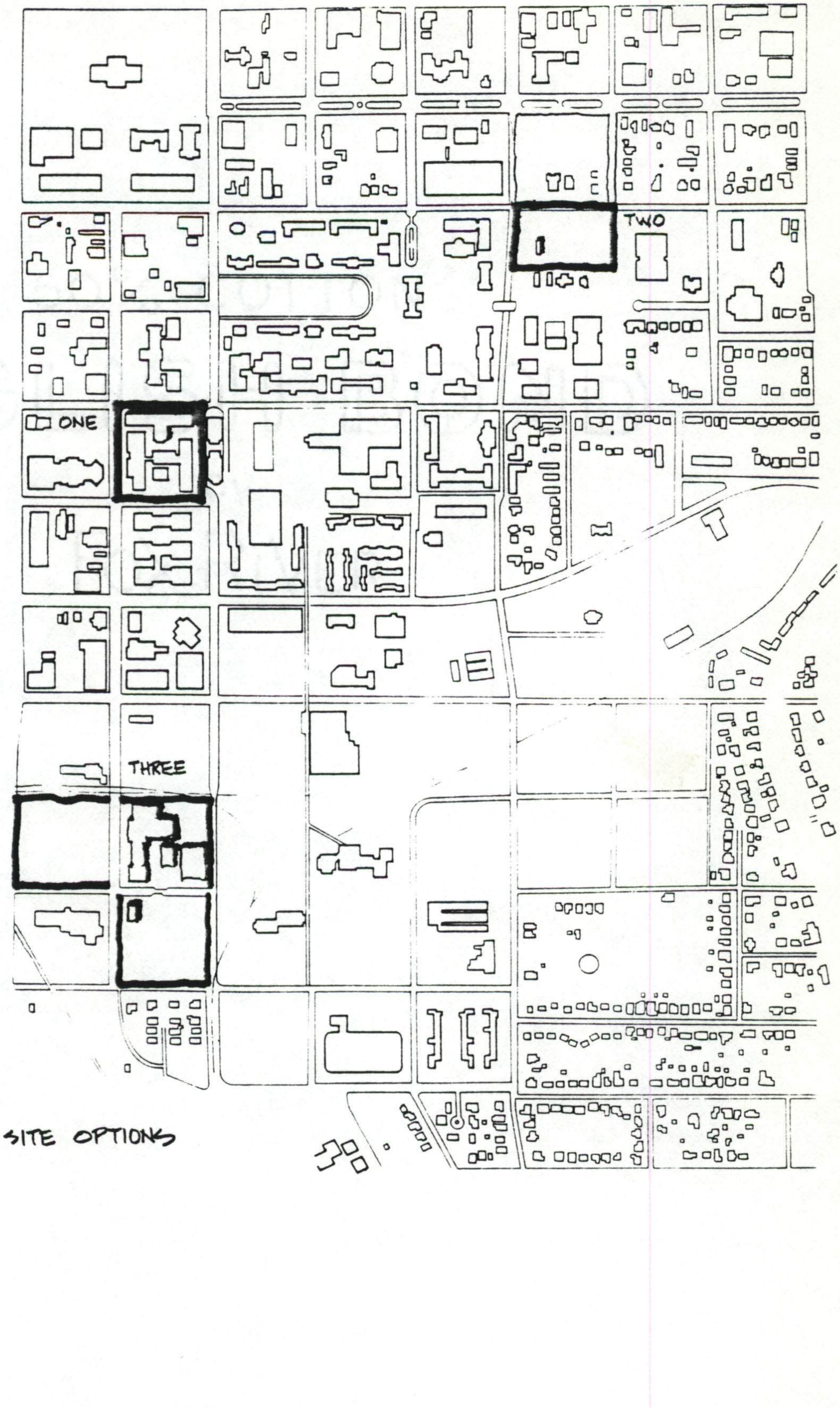
Continued development on the USC campus is somewhat restricted because of its city setting. There are, however, three possible locations for a new College of Engineering. The selection of a site will require an examination of the options for growth, available lands, and a site analysis. The advantages and disadvantages of each possible site will be considered.

SELECTION CRITERIA

The criteria are as follows. The USC campus fabric should be strengthened by the introduction of any new facility. The development of a facility must respond to intercollege relationships. Also, the facility must properly respond to campus movement and scale. The new facility must not infringe on the development of other departments or university neighbors. The school's facility should create a proper sense of place. And finally, the facility's service needs must be within the university's physical plant capabilities. The selection of a site must be conducive to the development of optimum facilities for the College of Engineering.

SITE OPTIONS

There are three options that the University could consider for the location of a new engineering school. The first is to expand the present facilities. Development on Gibbes Green is a second possibility. The third option is to consider expansion in the south campus area.

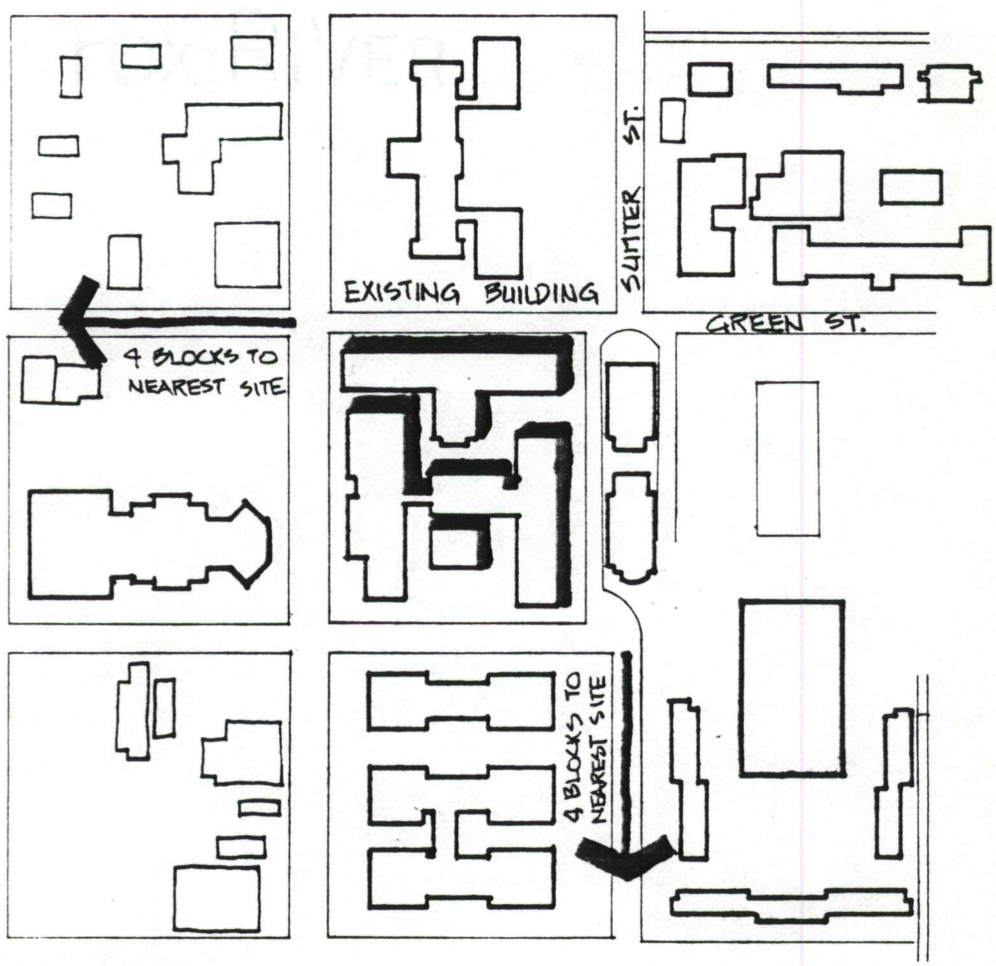


SITE OPTIONS

Option One: This alternative will look at the possibility of building a second facility in addition to the existing facility.

ADVANTAGES: This alternative would allow for a lesser amount of total new square footage to be constructed. In addition, the existing building would allow a portion of the College of Engineering to maintain a central campus location.

DISADVANTAGES: The existing location of the Sumwalt Engineering Building does not allow for adjacent expansion. The closest site for an additional structure is four blocks away. The administration does not want to divide the school's departments. Interrelationships between departments are critical in order to share laboratory and classroom space. This option would not solve inherent problems of the building's inability to adapt to changing technologies.

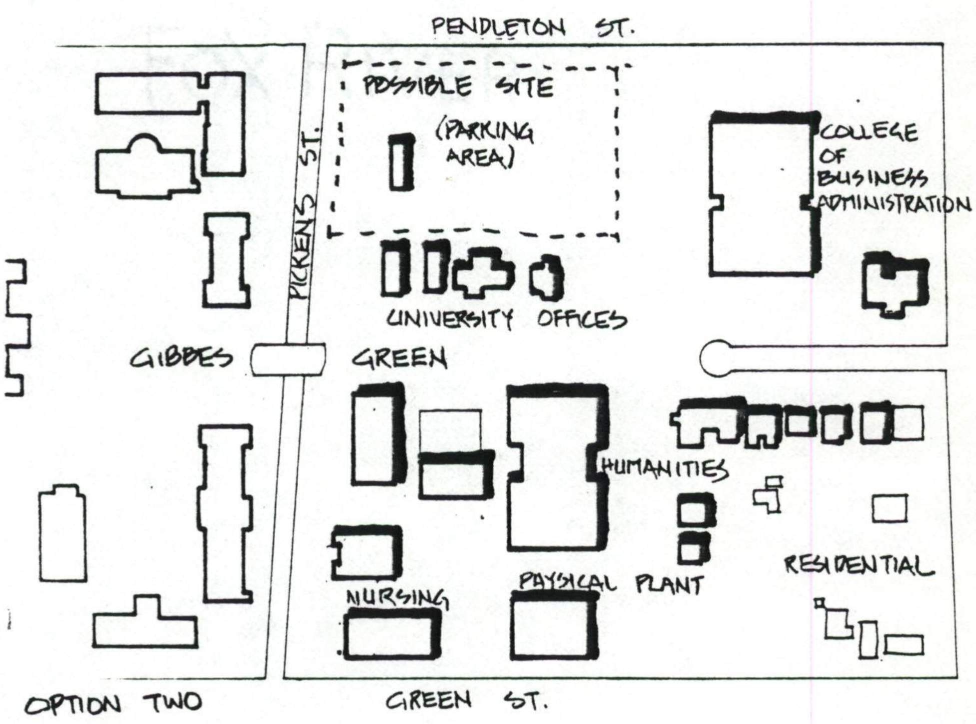


OPTION ONE

Option Two: The site under consideration is on Gibbes Green. This area of campus was developed in the 1970s and is uninterrupted by street traffic. On the backside of the historic Horseshoe, this setting is occupied by the humanities, social sciences, and business programs.

ADVANTAGES: This site would offer a strong central campus location for the engineering school and provide for a good relationship to the humanities. The use of this site would complete development in the Gibbes Green area which allows easy pedestrian access.

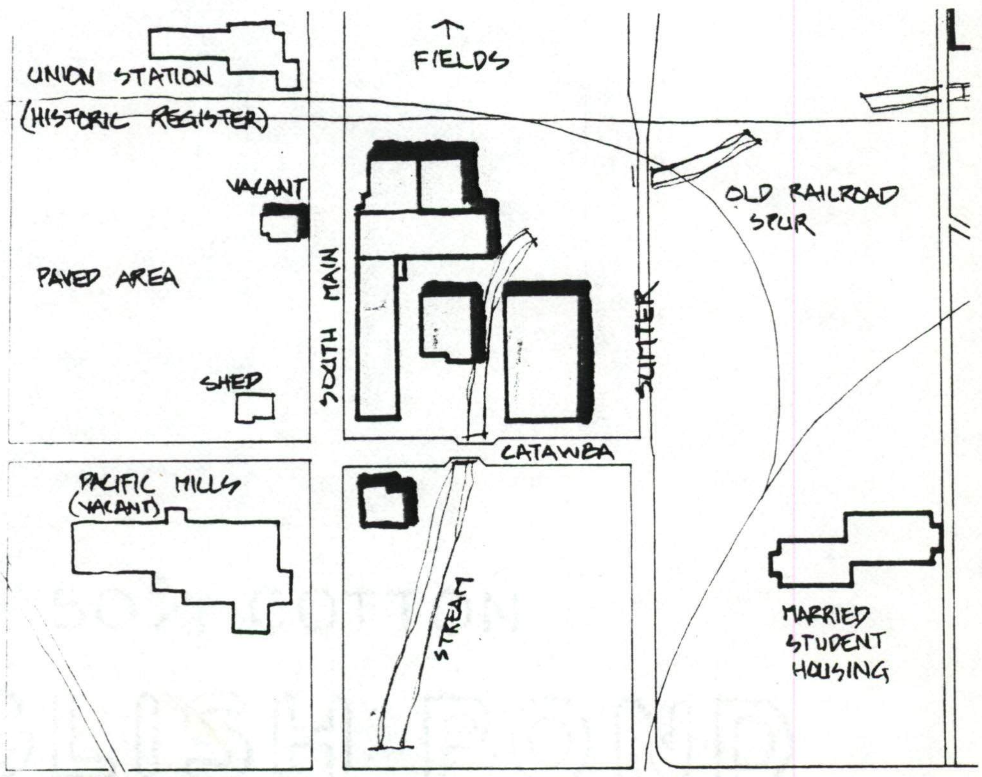
DISADVANTAGES: The selection of this site would not respond to to other campus growth trends and needs. Building on this site would remove the only major parking lot for faculty in that area of campus, and would present difficult new parking requirements. This option removes the chance for future development of the social sciences. Development of the proprosed program would introduce a building that would not be in the scale of the existing campus and surrounding neighborhood.



Option Three: Available land in the South Campus area is that which presently belongs to the South Carolina Electric and Gas Company. This property is being vacated by the company's move to new facilities. The property consists of a three block area with existing buildings occupying the block bordering other university property. The other two blocks are basically undeveloped with a portion of one paved west of Main Street.

ADVANTAGES: Development of this site could strengthen the South Campus fabric and provide a major activity node. The site is within close proximity to the sciences and major dormitory areas. An engineering center in this area would possibly be in the scale and character of existing, early 1900s, industrial buildings. Development would pose no threat to the neighbors and could encourage the redevelopment of historic buildings in the area. The possibility also exists for the university to retrofit some existing structures and capitalize on the concept of embodied energy in existing buildings. The university energy facilities in this area are capable of supporting a new facility. Land area is available for parking and the university shuttle route presently covers this part of campus.

DISADVANTAGES: The site is not physically close to the humanities, but the shuttle system would conveniently provide access to those areas. This location would also pose problems for the physical continuity of campus, yet this could be solved in time through development of grounds and facilities.

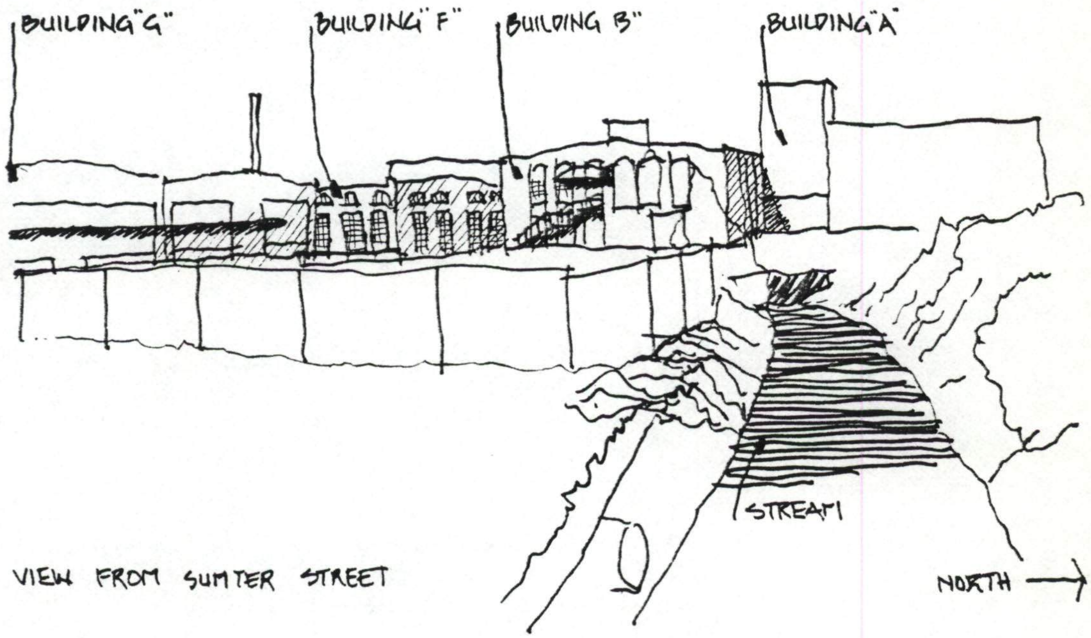


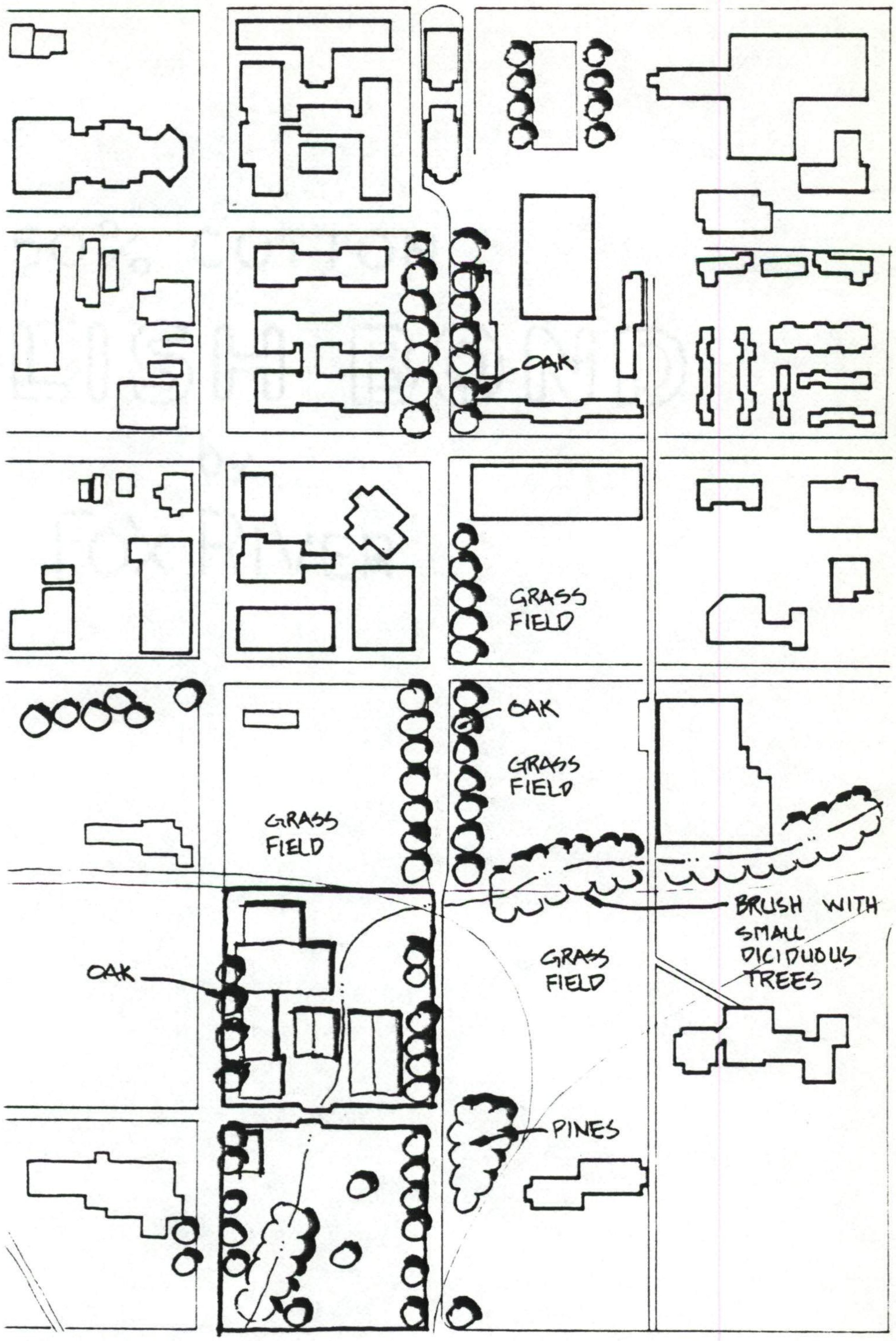
OPTION THREE

The implementation of the third option seems to provide USC and the College of Engineering with the best possibilites and long term benefits. Using the SCE&G facilities to some extent will allow a more complete development of the engineering school's needs. This site selection makes a positive gesture in completing and strengthening the South Campus image. Parking has been a long standing problem at the university and this area's land availabilty will allow growth.

SITE ANALYSIS

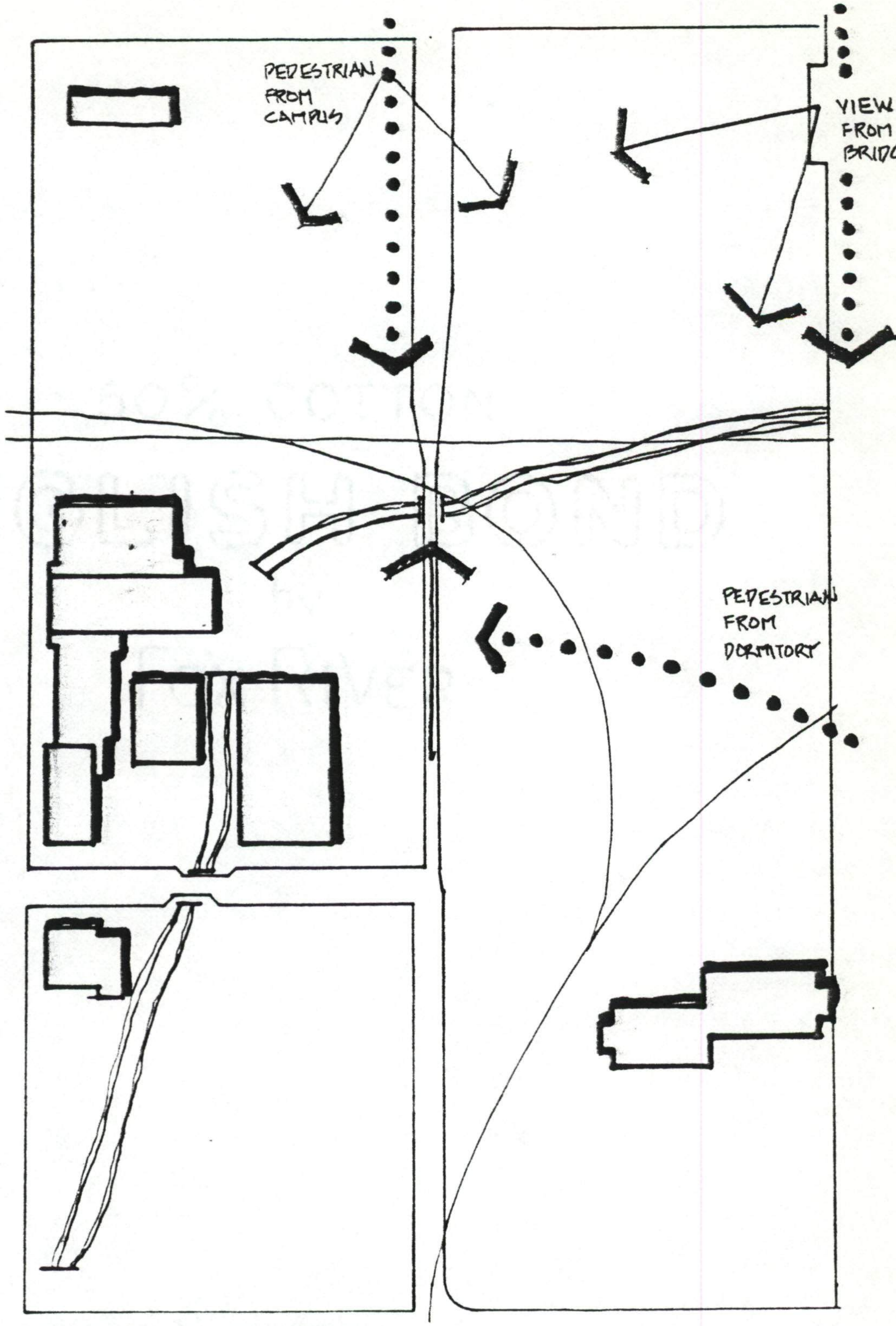
An analysis of the proposed site will determine, in more detail, the potential for physical development. The study will focus on developing a better understanding of the site's complexities. The characteristics of the site's image, environment, existing conditions, proposed conditions, and services will be included.



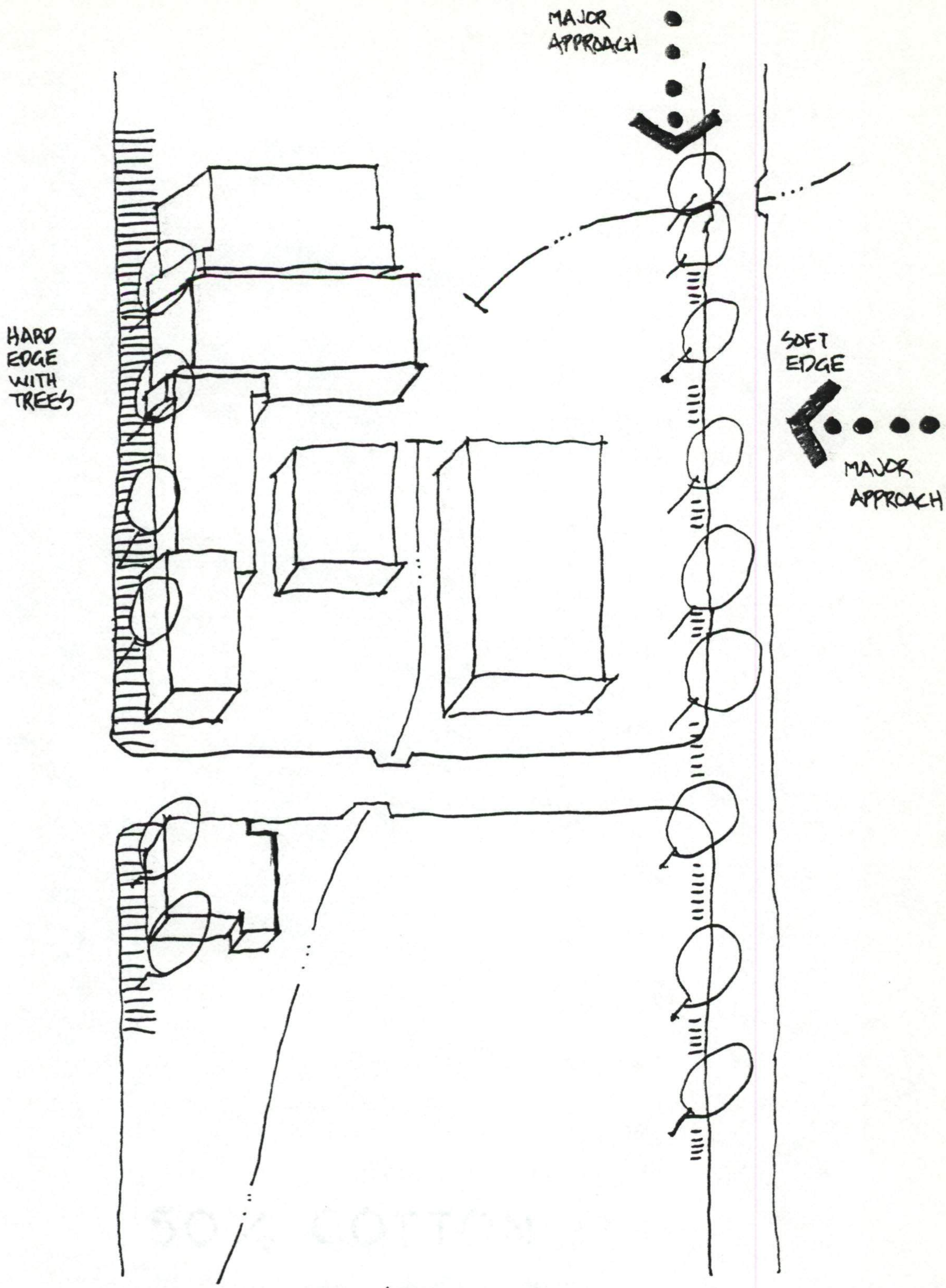


OAK
GRASS FIELD
OAK
GRASS FIELD
GRASS FIELD
BRUSH WITH SMALL DICIDUOUS TREES
OAK
GRASS FIELD
PINES

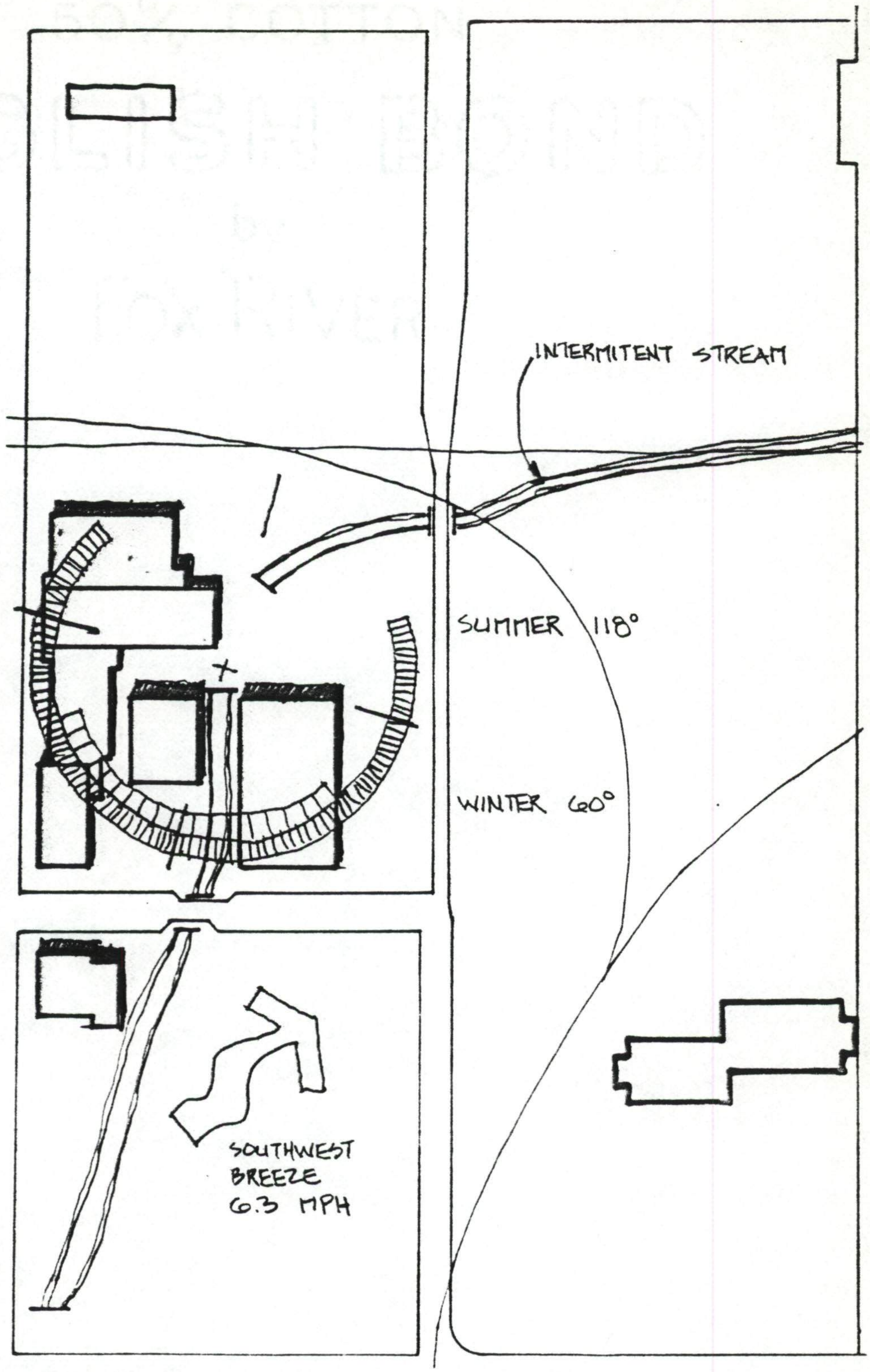
VEGETATION



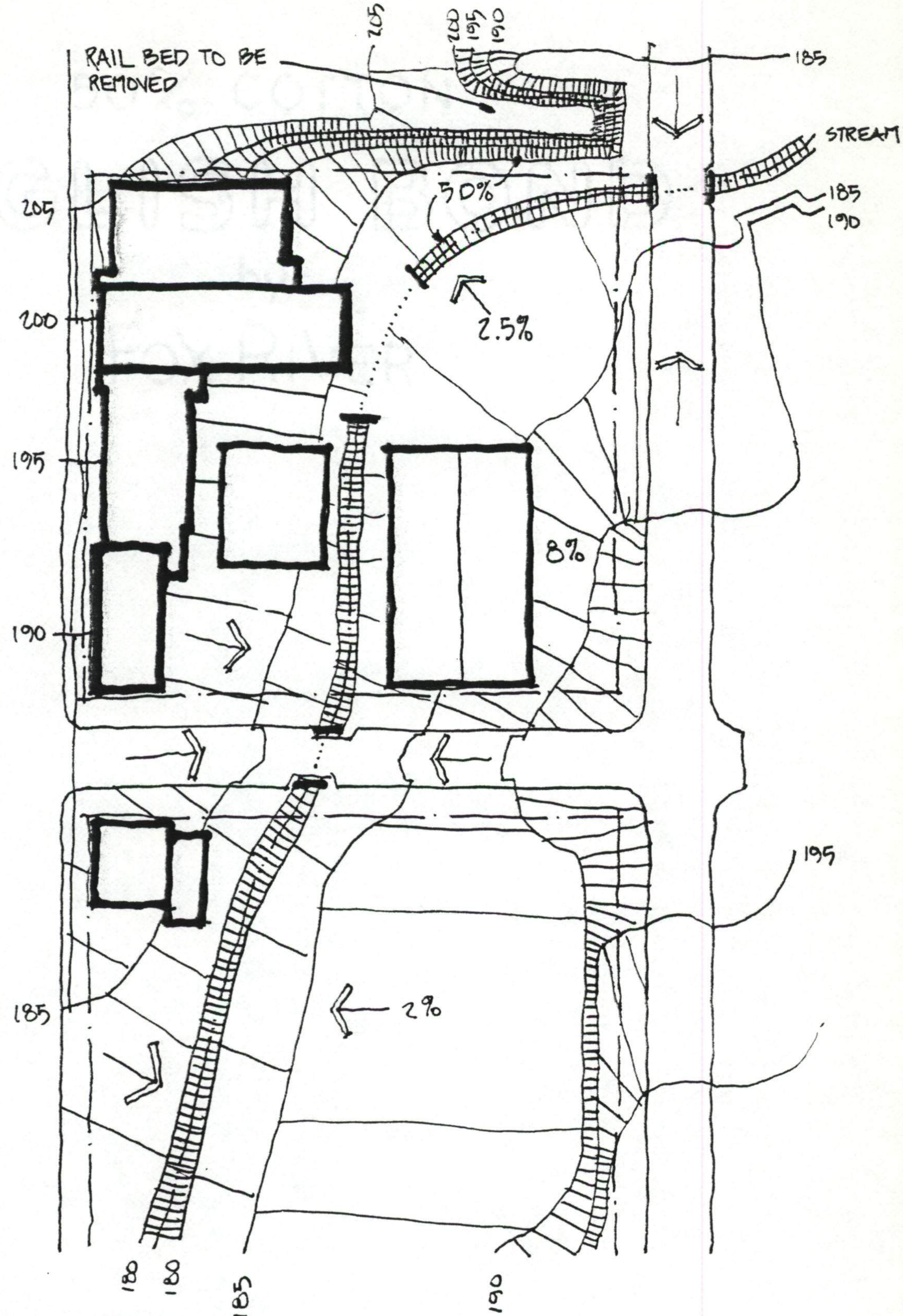
SPATIAL CHARACTER / MOVEMENT



SPATIAL CHARACTER / AXONOMETRIC



ENVIRONMENT



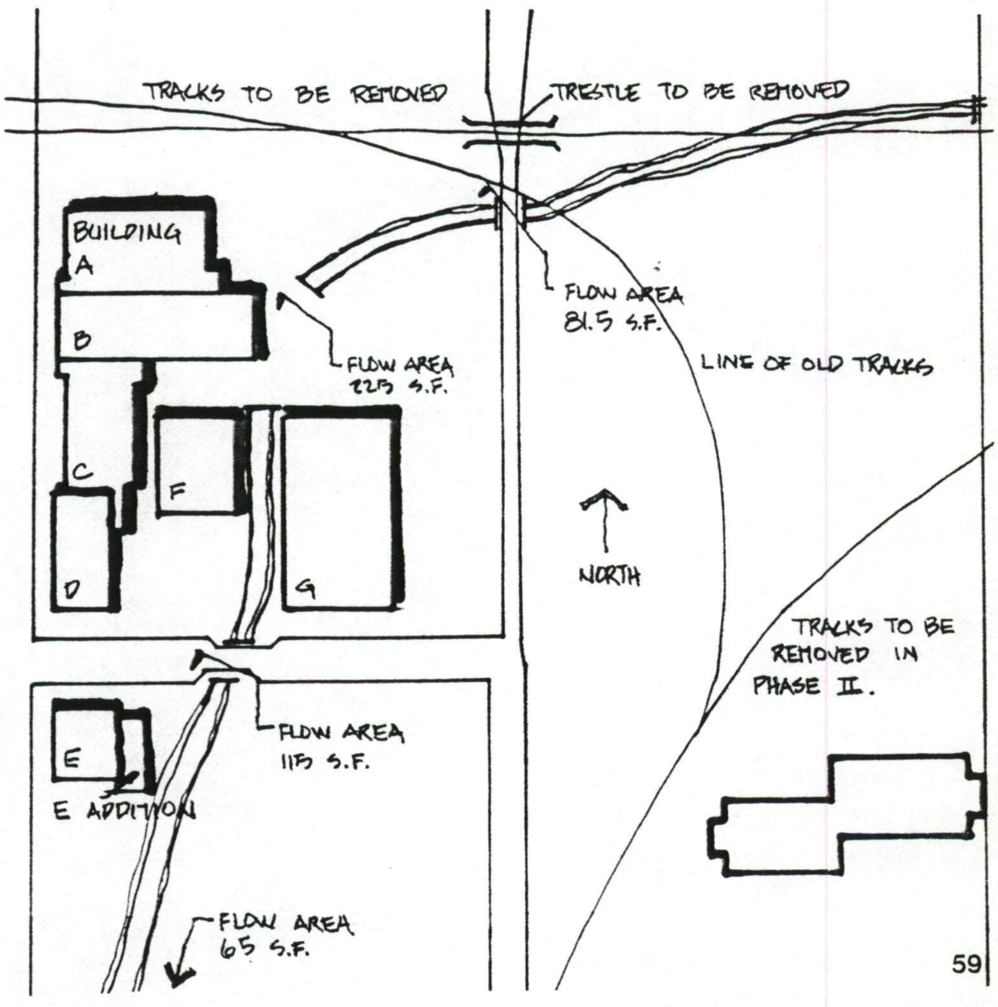
TOPOGRAPHY / HYDROLOGY

EXISTING BUILT CONDITIONS

Site: Railroad tracks to the north side of the site will be removed as part of the 'Proposed Railroad Relocation, Consolodation and Grade Crossing Elimination Project' which is currently under construction in Columbia. It is expected that the easement property will be transferred to the University of South Carolina. Work will include removal of the tracks, the earthen track bed, and a small trestle.

The U.S. Geological Survey classifies the stream running through the site as intermittent. A series of underground structures along the stream inhibit the flow and occasionally cause minor flooding. A continuous maximum flow area of 200 square feet should be provided. The existing structures, however, allow only for 65 to 225 square feet of net flow area.

The site contains eight structures each with different conditions. In the four structures fronting Main Street, the floor heights are inconsistent with level changes. These average seven vertical feet between buildings. The other three buildings are free standing.

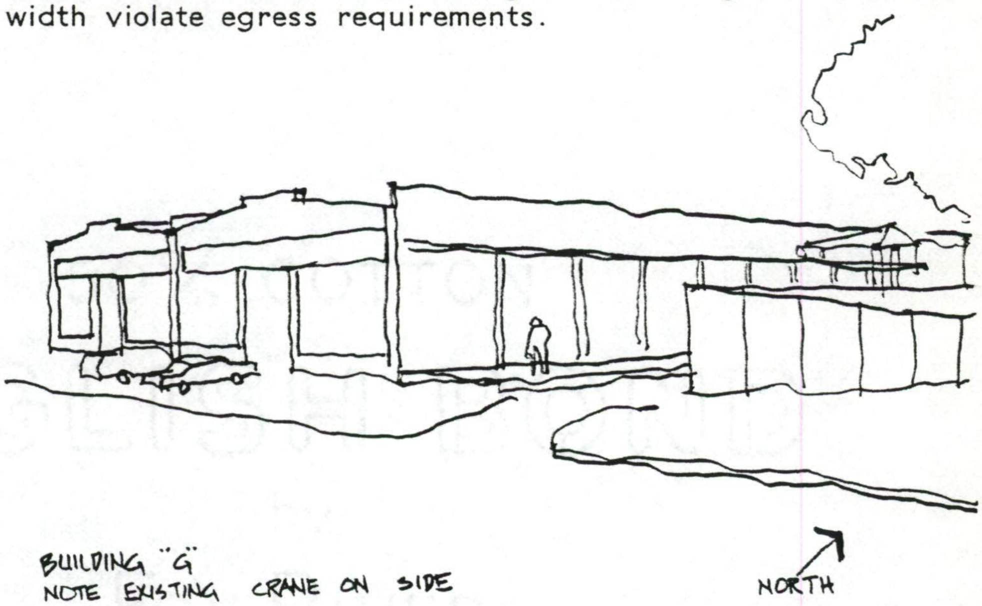


Building A: This four story, concrete, structure was built in 1962. Column spacing is twenty feet on center with floor to floor heights of eleven feet. The building violates numerous codes including: dead end corridors, inadequate stair widths, and handicap access. Its two basement levels are prone to water seepage. This building has no historical significance.

Building B: This masonry walled structure was constructed c1886 as a car barn for Columbia's street car system. A 'new facade' was added in the 1960s. Floor to floor heights are 16 feet and columns occur at third points across the 70 foot wide building. Floors are capable of withstanding +125 pounds per square foot live loads. At present, the building's floor area is unobstructed, so codes must be met with any new construction. Windows have arched masonry openings.

Building C: Built in 1970, this building is a two story structure with a penthouse area. The structure is steel framed with open web steel joists and is faced with a brick veneer. This building houses offices, many of which have no natural light. It also violates egress and handicapped codes in stairwells and corridors.

Building D: This building was built in three phases. The older part was constructed in the 1930s and additions have complicated the usable space. Column spacings are irregular in the two story structure and vary from ten to fifteen feet. Minor level changes and changes in corridor width violate egress requirements.



BUILDING "G"
NOTE EXISTING CRANE ON SIDE

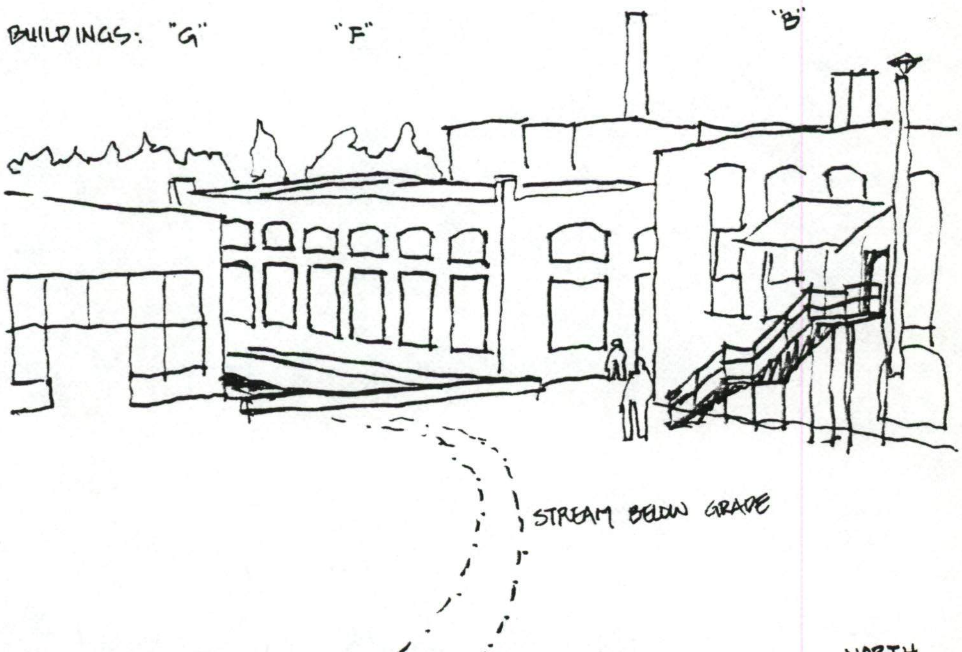
Building E: This building is sited across Catawba Street, away from the other structures. The masonry walls average one foot in thickness and include arched openings. A second level was added within the building using steel framing and concrete slabs. A brick veneer was applied in 1970 with a ribbed metal facia "for aesthetic reasons." A small office addition to the east was also added at this time.

Building F: This 1920s building is basically intact, and the floor area is unobstructed. Steel trusses span the 8000 square foot space. The building is typical of early twentieth century industrial architecture.

Building G: This building was built some time before the 1950s as a bus barn for South Carolina Electric and Gas transit services. The open interior area has a clear height of 16 feet to the bottom of the trusses. The floor is specifically designed for venting exhausts and supporting large dynamic loads.

CONCLUSION

The site poses difficult problems, yet contains buildings useful as engineering laboratories. It lacks order from the University approach as well as from within existing structures. The site is also bisected by a stream that has posed problems in the past. Existing builings must be carefully understood in relation to engineering education, occupancy, usefulness, and significance.



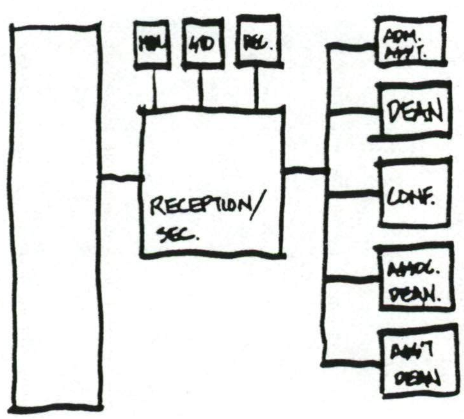
THE THREE LARGE EARLY INDUSTRIAL BUILDINGS
(PACIFIC MILLS IN BACKGROUND)

COMPONENTS AND THE FACILITY PROGRAM

Activities of the College of Engineering have a physical impact on the facilities. Component spaces are created out of these activities and include administrative areas, departmental areas, educational facilities, and laboratory spaces.

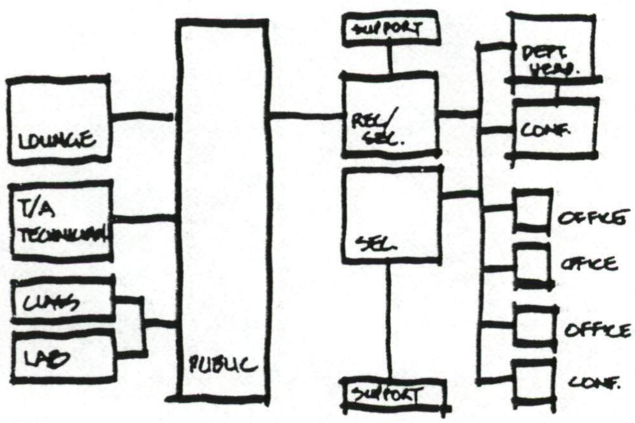
ADMINISTRATION

The Administration is headed by a dean. This complex should be in a central location for accessibility. An assistant dean is also in this complex. Each dean should have his own office and should relate to a reception area of staff assistants and a conference room. These assistants should have access to storage areas for correspondence, student records, and research files. A copy and mail room should also be convenient to the assistants. For student advising, the College has an associate dean. This office and reception area should have a student waiting space and conference room. The business manager will require an office and storage area for files and materials.



DEPARTMENTS

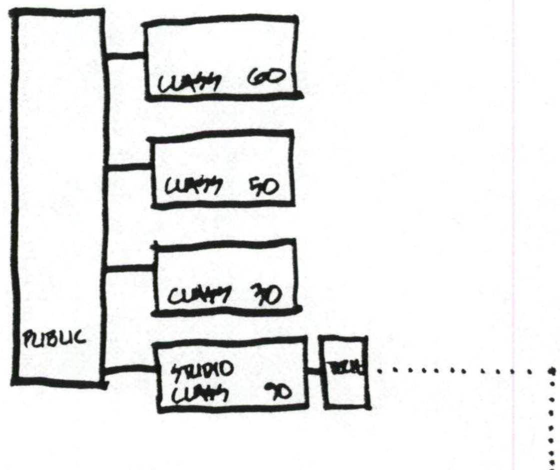
There are four departmental areas with individual administrations, faculty, and teaching assistants. Each department is organized in a similar manner. A common secretarial/reception area should be convenient to all faculty. Each department will require an area for document storage, a copy/mail room, and a lounge/conference room. Faculty offices will be provided for all faculty members, and should have access to teaching assistant (T/A) areas. T/A cubicles will be used for grading, research, and individual student work. All offices and a portion of the T/A areas will be wired for communications equipment. Areas not directly related to department offices include a lab technician's office and a student lounge for each engineering society. For better interaction, departments should group offices of research and teaching faculty. This will require that office spaces should be relatively convenient to both laboratories and classrooms.



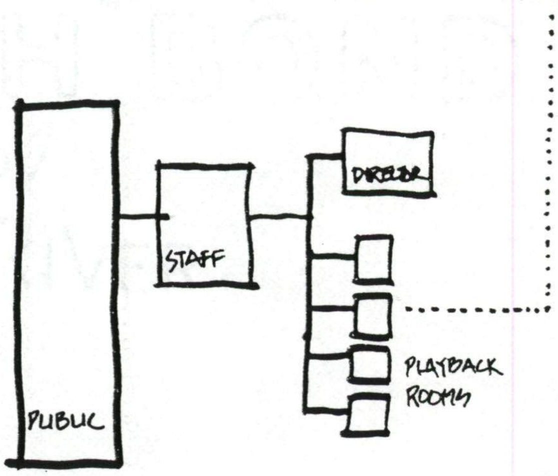
SHARED FACILITIES

Educational component areas are grouped according to activities and programs of the College. These spaces include the classrooms, the APOGEE area, the computer center, and the continuing education facilities.

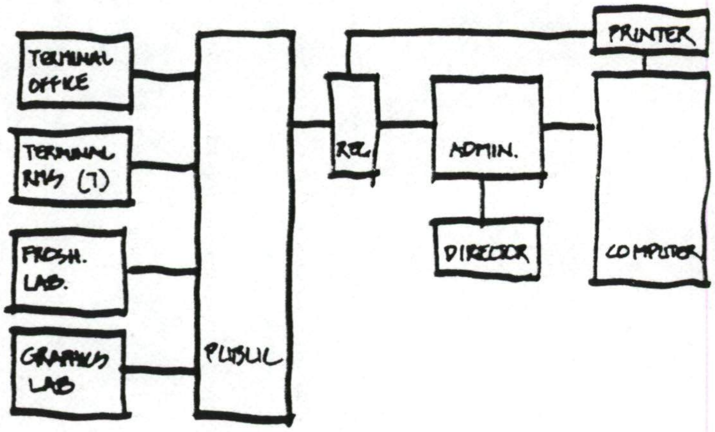
The number of classrooms required was determined by the College according to predicted enrollments and possible class schedules. Departments will share classroom space to avoid duplication of spaces. Classrooms should have tiered seating to promote better attention during lectures. Demonstrations may also occur during class. This will require hallways and doorways of adequate width for equipment.



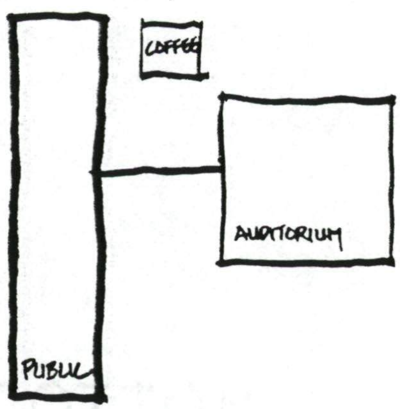
The APOGEE Center operates classroom studios with video taping equipment areas in them. These classrooms will accomodate ninety students and may be in the general classroom area. The equipment areas will be wired to playback rooms in the administrative area of the center. One coordinator and an assistant will operate this program.



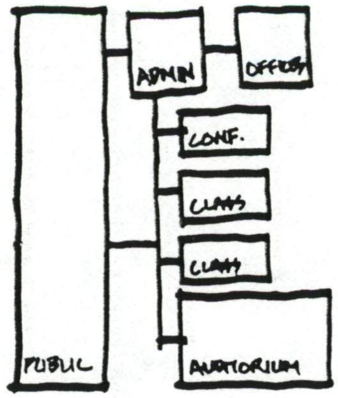
Another important educational facility is the Computer Center. The computer room requires no direct contact to the public. However, throughout the College there will be terminals, terminal rooms, a graphics lab, and a printer room. Terminal rooms should be convenient to laboratories and student study areas. The entire engineering facility should be wired to accommodate terminals and related communications equipment in the future. An office for the director and assistants should be provided with access to the computer room.



An auditorium will be provided for conferences, lectures, and demonstrations. The lobby space for the auditorium should be large enough to accommodate registration for conferences, exhibitions and displays, and a refreshment area. The exhibition area should also include an outdoor space for large equipment and group gatherings.

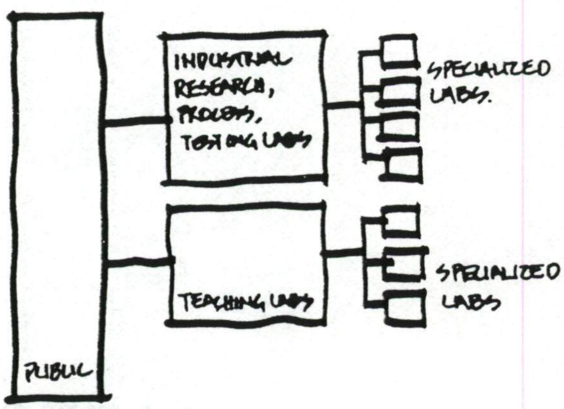


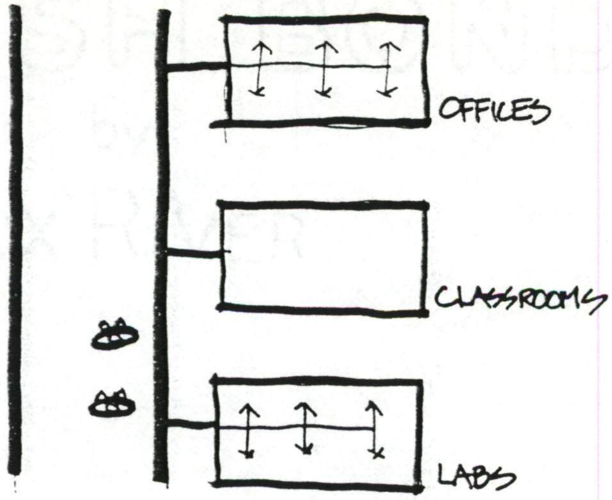
The Continuing Education Center operates independently from other educational areas in the College. The Center's activity requires classroom space that will not conflict with regular class schedules. Two small classrooms will be required in addition to the center's auditorium. A common area will accommodate gatherings for refreshments. Office areas should accommodate one director, three assistants, and two staff members.



LABORATORY GROUPS

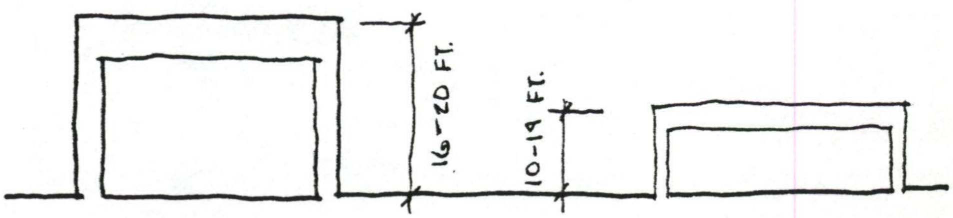
Laboratory groupings are somewhat complex. The overall groupings are through departmental and technological lines. Because departments control their own laboratories this grouping is the most satisfactory for the school. Certain labs, however, contain similar technologies. Service and equipment needs may be reduced by grouping or combining labs from different departments. Within the departments, labs are grouped by their activity role of either primary/teaching labs or specialized/research labs. After considering these guidelines, lab spaces are categorized as high-bay or low-bay and heavy-equipment or light-equipment.



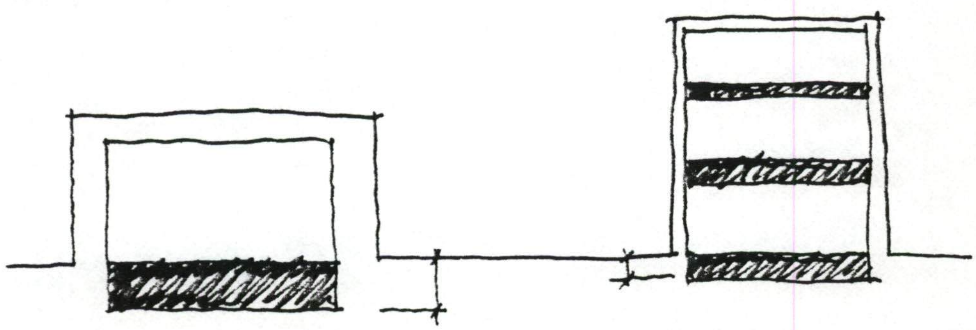


INTER-DISPERSED FUNCTIONS:

LABORATORY TYPES:



HIGH-BAY LOW BAY

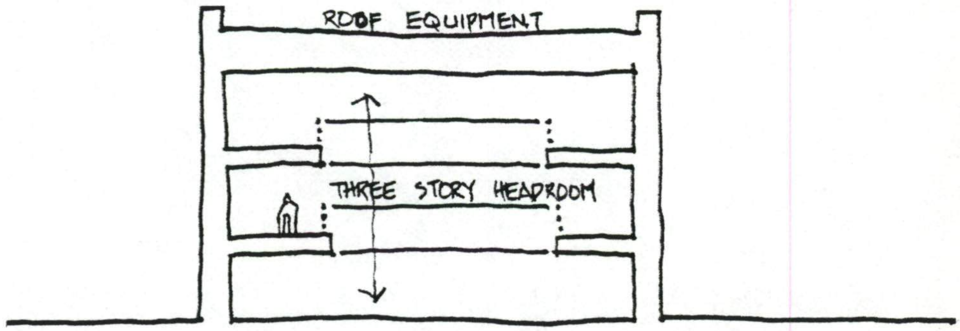


HEAVY EQUIPMENT

MULTI-STORY
LIGHT EQUIPMENT

CHEMICAL ENGINEERING

The Chemical Engineering laboratory group consists of unit operations laboratories, graduate research areas, and faculty reasearch labs. The Unit Operations Lab A is a heavy equipment three story space. The area is used for the development of chemical processes and production. The vertical space is continuous with two perimeter mezzanine levels. The space should have noise isolation, ventilation, removable grates between floors, and services available at all points. The services include high- and low-pressure steam, water, compressed air, and some bottled gasses.



The Unit Operations Lab B is similar to the previous lab, but it is a one story space with smaller and less noisy equipment. This lab is considered to be a light equipment space. Both unit op labs should be accessible to parts storage, the shop, and research areas.

The faculty and graduate research labs are for small controlled chemical experimentation. These labs should contain the services found in the larger chemical engineering labs. Ventilation is extremely important as are wet chemical areas.

CIVIL ENGINEERING

The Civil Engineering group is comprised of testing laboratories as well as environmental engineering facilities. These labs, generally, need large service areas.

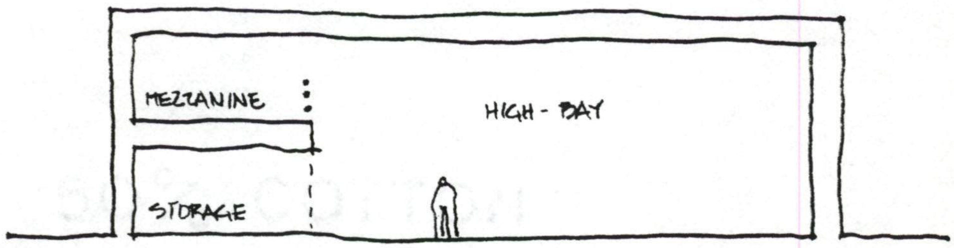
The Structural Testing Lab requires a high-bay space with an overhead crane for moving materials. The floor system will be subject to dynamic loading. Equipment in this area will be heavy and the space requires a ground floor relation. Services include compressed air, hydraulic systems, and computer lines for measurements.

The Soils Lab requires a low-bay space for the testing and studying of soil properties. This lab contains sensitive equipment and will require a floor system that is relatively free from vibrations. Some heavy equipment will be stored in the space for testing. Moist storage for soil samples as well as other storage areas will be necessary. Ventilation is important.

Materials Testing is found in both the civil and mechanical engineering groups. This lab requires a floor system that is capable of dynamic loading, and a ventilation system to remove airborne debris. The testing of materials requires an environmental chamber and heavy equipment. Storage for materials and equipment must be provided.

Hydraulics Water Research involves the study of waves, tides, and currents. This space must be two story in order to provide proper fluid pressures in controlled experiments. Again, civil and mechanical engineering have similar technologies. A Fluid Dynamics area will be provided in the lab. A water tank must be provided as well as equipment storage areas.

At USC, the Environmental Process Lab is in the civil engineering department. A two story space must be provided with a mezzanine level. This lab should relate to the hydraulics group. The space should provide for chemical handling and storage. A Wet Chemistry Lab should be provided for teaching and research. These lab areas demand chemically resilient surfaces and proper ventilation.

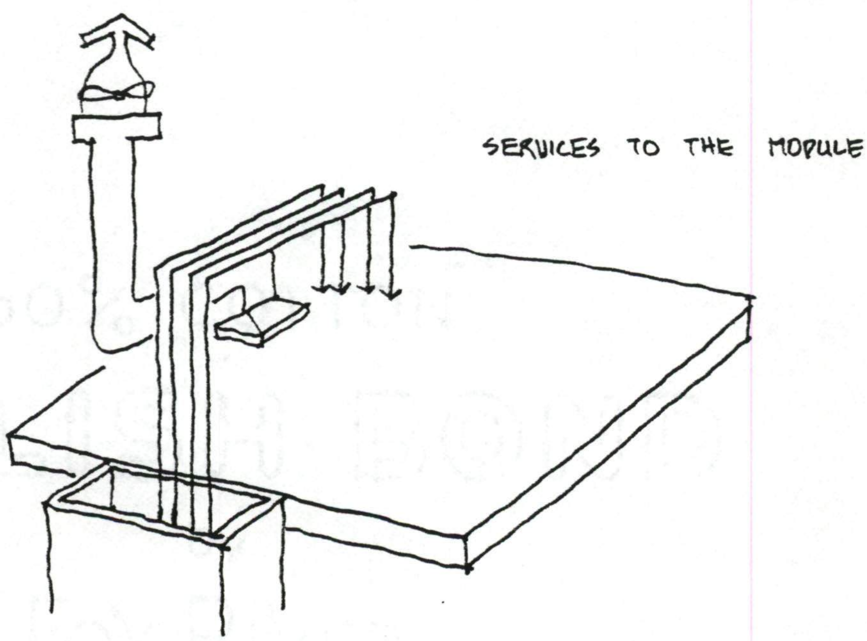


HIGH BAY CIVIL ENGINEERING LAB.

The civil engineering department requests that there be demonstration classrooms provided near the laboratory areas. These classrooms should provide storage areas for demonstration equipment belonging to the major lab types. Computer services should be provided to these areas for measurements and computer model analysis. One laboratory space, Mechanics Testing, will be grouped with the mechanical engineering labs because of similar design constraints. In conclusion, the civil engineering lab group consists primarily of testing and research spaces. These labs should have easily accessible service areas. A close relation should be made to the mechanical engineering labs because of the shared areas.

ELECTRICAL AND COMPUTER ENGINEERING

Electrical and Computer Engineering labs are primarily light-equipment and low-bay spaces. The lab groups for Electrical and Computer Engineering are broken into three categories. The first group consists of teaching and primary lab spaces. In addition to these labs the ECE department will have its own microcomputer and terminal room. The second group of labs are for computer engineering and are composed primarily of specialized computer design labs. The third group of labs are specialized electrical engineering spaces. This last group includes a few heavy equipment labs. These labs generally require a low-bay space designed for light-equipment. If properly arranged the lab areas could be designed on a module. The physical characterisitcs of these labs should allow for vibrationless floors, ventilation and fume hoods, clean bench areas, and small teaching areas. Systems should allow flexible arrangements and should include gas lines, compressed air, vacuum lines, waste disposal lines, communications wiring, and 120 and 220 electrical current.



The Computer Design Laboratories are specialized areas that also may be designed on a module. Two spaces, Software Research and Computer Research, are laboratories that primarily require computer terminals and work areas. CAD and VLSI Design, Computer Design Research, and Control and Communications Labs should have computer terminals, vibrationless floor areas, ventilation and bench areas, and allow the possibility of adding required services.

Distributed Knowledge-Based Systems, Sensor Research and Signal Process, Vision and Speech, and Robotics are all low-bay and light-equipment laboratory areas. These labs test the operational qualities of computer controlled working systems. The floor systems should be relatively rigid. The laboratories should be clean spaces that provide bench work areas. These labs should have the possibility of forming a linear space if production process research is implemented.

The Microelectronics Lab, Fields/Microwaves and Research Lab, Printed Circuits Lab, and Optics and Laser Labs are specialized components of electrical engineering. These labs should have the capability of receiving all systems. Of primary importance are floor systems that are relatively free from vibration, bench areas, and proper liquid waste disposal systems. Lightweight and sensitive equipment will be used in these areas.

The High Voltage Lab and the Machinery and Power Systems Labs are also specialized labs in electrical engineering. These labs, however, are considered heavy-equipment areas because they impose certain demands on the space. The High Voltage Lab should be a high-bay space. It should have well insulated wall areas and be capable of handling heavy high voltage equipment and systems. The High Voltage Lab and the Machinery and Power Systems Lab may be grouped in a separate area with a different physical character than the other electrical and computer engineering labs.

MECHANICAL ENGINEERING

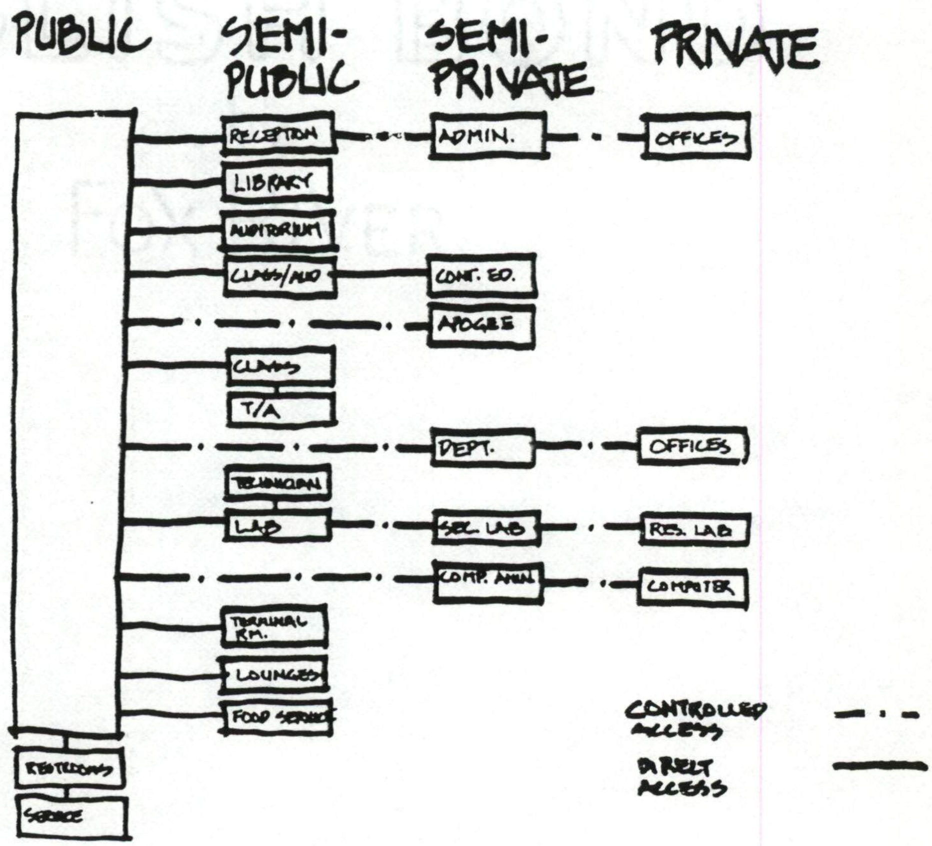
The last laboratory group is that of mechanical engineering. Remember that the Fluid Dynamics Lab and the Materials Lab were grouped with civil engineering. The Mechanics Testing Lab of civil engineering is grouped with a similar lab in the mechanical engineering group. The energy lab deals with material combustion in small furnaces and engines. The College is also conducting research into solar applications and alternate energy systems. This lab should handle heavy equipment but does not require a high-bay.

The Process and Control Lab is a high-bay lab used for studying industrial processes and quality control. The space should contain a crane and be easily serviceable. Heavy equipment will be used in the space. A mezzanine level for servicing and observation should be provided.

The mechanical engineering department has requested unassigned low-bay research space that would accommodate light-equipment. Systems will consist primarily of ventilation and communications wiring.

CONCLUSION

In conclusion, laboratory spaces will be divided along departmental lines in most cases. The labs should then be grouped according to physical and technological demands. Access from classroom areas to the laboratory should be easy. Labs must be controlled, however, because of expensive and potentially dangerous equipment. Students and faculty should be encouraged to utilize both technical and study oriented spaces in the educational process. Requirements for spacial accessibility are defined on a scale showing public to private relationships.



THE PROGRAM

	Occupancy	No. Required	
DEAN'S COMPLEX:			
Dean	1	1	350
Assistant Dean	1	1	250
Admin. Asst.	1	1	250
Secretarial Area	5		1000
Conference		1	250
Copy/ Storage		1	150
BUSINESS OFFICE:			
Director	1	1	150
Assistant	1	1	150
ADVISING OFFICE:			
Associate Dean	1	1	250
Secretarial/Staff	3		600
Waiting Area	20		400
Conference		1	250
Storage/Copy			150
CHEMICAL ENGINEERING DEPARTMENT:			
Chairman	1	1	200
Secretary/Reception	1	1	200
Conference		1	200
Copy/Mail		1	200
Faculty Area		1	165
Storage/Supplies		1	165
Faculty Offices	1	16	100
Secretarial	2		400
T/Asst.	30		2500
Technician		1	400

CIVIL ENGINEERING DEPARTMENT:

	Occupancy	No. Required	
Chairman	1	1	200
Secretary/Reception	1	1	200
Conference		1	200
Copy/Mail		1	200
Faculty Area		1	165
Storage/Supplies		1	165
Faculty Offices	1	22	100
Secretarial	2		400
T/Asst.	30		2500
Technician		1	400

MECHANICAL ENGINEERING DEPARTMENT:

	Occupancy	No. Required	
Chairman	1	1	200
Secretary/Reception	1	1	200
Conference		1	200
Copy/Mail		1	200
Faculty Area		1	165
Storage/Supplies		1	165
Faculty Offices	1	22	100
Secretarial	2		400
T/Asst.	30		2500
Technician		1	400

ELECTRICAL AND COMPUTER ENGINEERING DEPT:

	Occupancy	No. Required	
Chairman	1	1	200
Secretary/Reception	1	1	200
Conference		1	200
Copy/Mail		1	200
Faculty Area		1	165
Storage/Supplies		1	165
Faculty Offices	1	32	100
Secretarial	2		400
T/Asst.	60		5000
Technician		1	400

	Occupancy	No. Required	
SHARED FACILITIES:			
Classroom/Studio	90	3	1350
Classroom A	60	6	900
Classroom B	50	2	700
Classroom C	30	6	450
STUDENT AREAS:			
AICHE Lounge/Room		1	800
ASCE Lounge/Room		1	800
IEEE Lounge/Room		1	800
ASME Lounge/Room		1	800
Food Service		1	600
APOGEE CENTER:			
Coordinator	1	1	200
Staff	1	1	200
Playback Rooms	1	4	100
COMPUTER CENTER:			
Computer Room		1	2000
Printer Room		1	600
Director	1	1	200
Terminal Rooms		9	400
Graphics Lab		1	1000
AUDITORIUM AREA:			
Auditorium	400	1	3200
Exhibit/Public Area		1	3000
Reading Room		1	2000
CONTINUING EDUCATION:			
Auditorium	100	1	1500
Classroom	30	2	500
Director	1	1	200
Assistant	1	1	200
Staff	2		400
Conference		1	200

	Occupancy	No. Required	
CHEMICAL ENGINEERING LABORATORIES:			
Unit Operations A		1	1600
Unit Operations B		1	1600
Faculty Lab	3	3	900
Graduate Lab	4	3	900
Repair Shop		1	200
Glass Storage		1	200
Equipment Storage		1	200
Spare Parts		1	200
CIVIL ENGINEERING LABORATORIES:			
Structural Testing		1	2700
Hydraulic Supplies		1	300
Computer Area		1	400
Equipment/Tool		1	400
Soils Testing		1	2000
Equipment Storage		2	400
Moist Storage		1	200
Materials Testing		1	2700
Materials Storage		1	500
Storage		1	300
Environmental Engineering		1	3600
Wet Chem Lab		1	1500
Instrument		1	800
Storage		2	400
Hydraulics		1	3000
Storage		1	400
Demo-Classrooms		3	600
Storage		3	125

ELECTRICAL AND COMPUTER LABORATORIES

Circuit	1	900
Logic Design	1	900
Elect., Design, Instrument	3	900
Microcomputer	1	2000
Interfacing	1	900
Terminal	1	900
Software	1	900
Computer Research	2	900
CAD and VLSI	2	900
Control and Communications	1	900
Knowledge-Based Sys.	1	900
Sensor and Signal	1	900
Vision and Speech	1	900
Robotics	1	900
Microelectronics	2	900
Printed Circuits	1	900
Fields and Microwaves	1	900
Optics and Laser	1	900
High Voltage	1	2000
Machinery and Power Systems	3	900

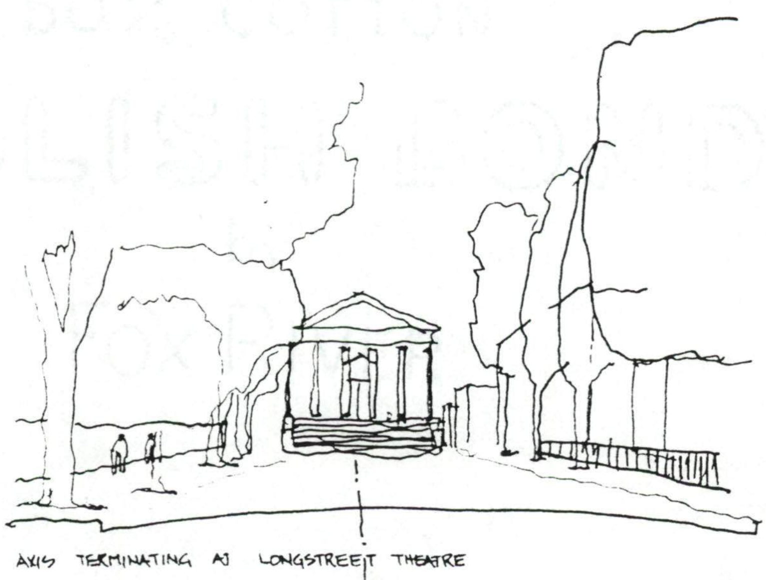
MECHANICAL ENGINEERING LABORATORIES:

Numerical and Process Control	1	5000
Mechanics Testing	1	1500
Energy	1	1500
Measurements	1	1000
Microscopy	1	1000
Research		5000

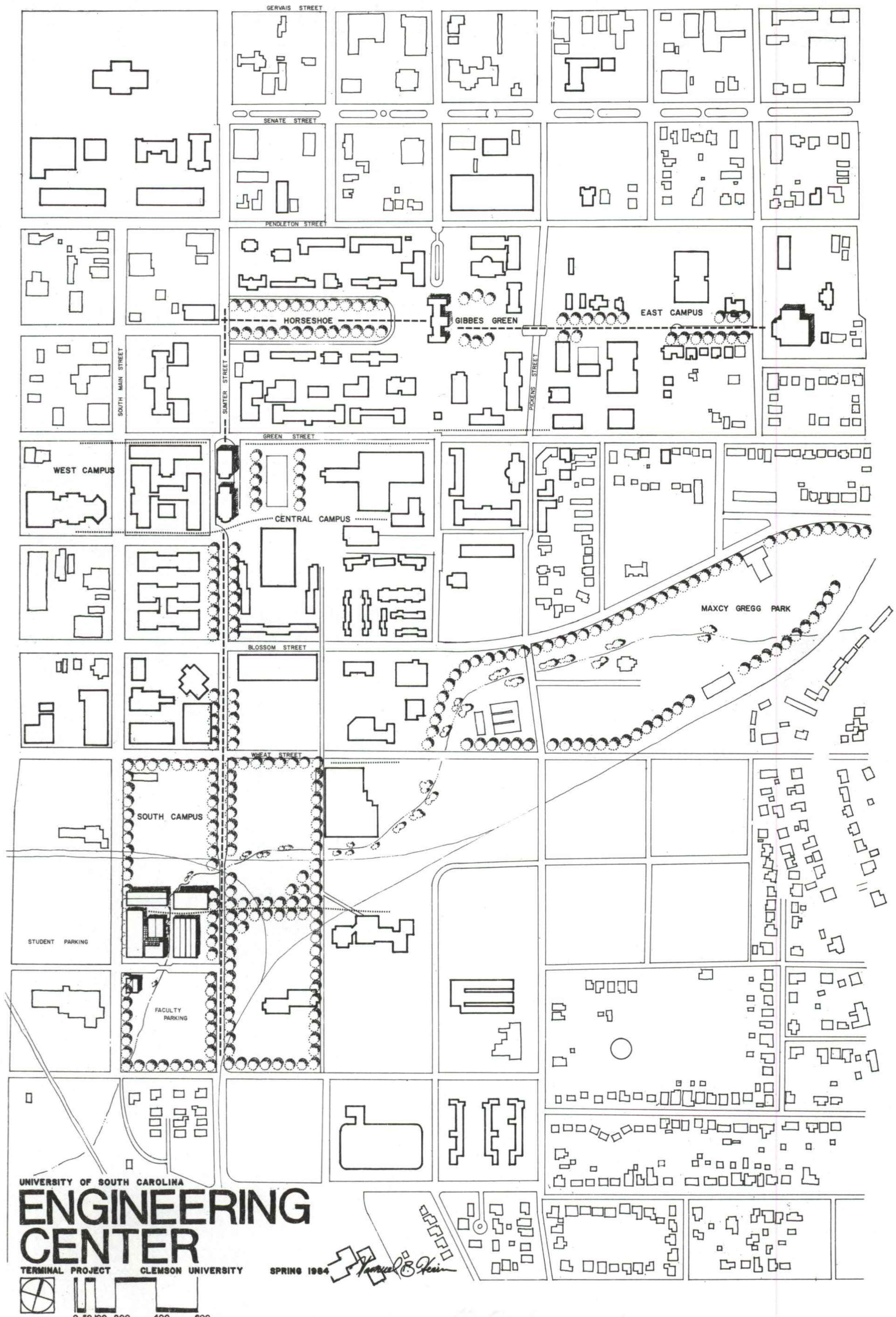
NET SQUARE FOOTAGE	175,000

THE GRAPHIC SOLUTION

AXIS TERMINATING AT McKISSIK MUSEUM



AXIS TERMINATING AT LONGSTREET THEATRE


GERVAIS STREET
SENATE STREET
PENDLETON STREET
HORSESHOE
GIBBES GREEN
EAST CAMPUS
SOUTH MAIN STREET
SUMTER STREET
PICKENS STREET
GREEN STREET
WEST CAMPUS
CENTRAL CAMPUS
MAXCY GREGG PARK
BLOSSOM STREET
WHEAT STREET
SOUTH CAMPUS
STUDENT PARKING
FACULTY PARKING
UNIVERSITY OF SOUTH CAROLINA
ENGINEERING CENTER
TERMINAL PROJECT
CLEMSON UNIVERSITY
SPRING 1984
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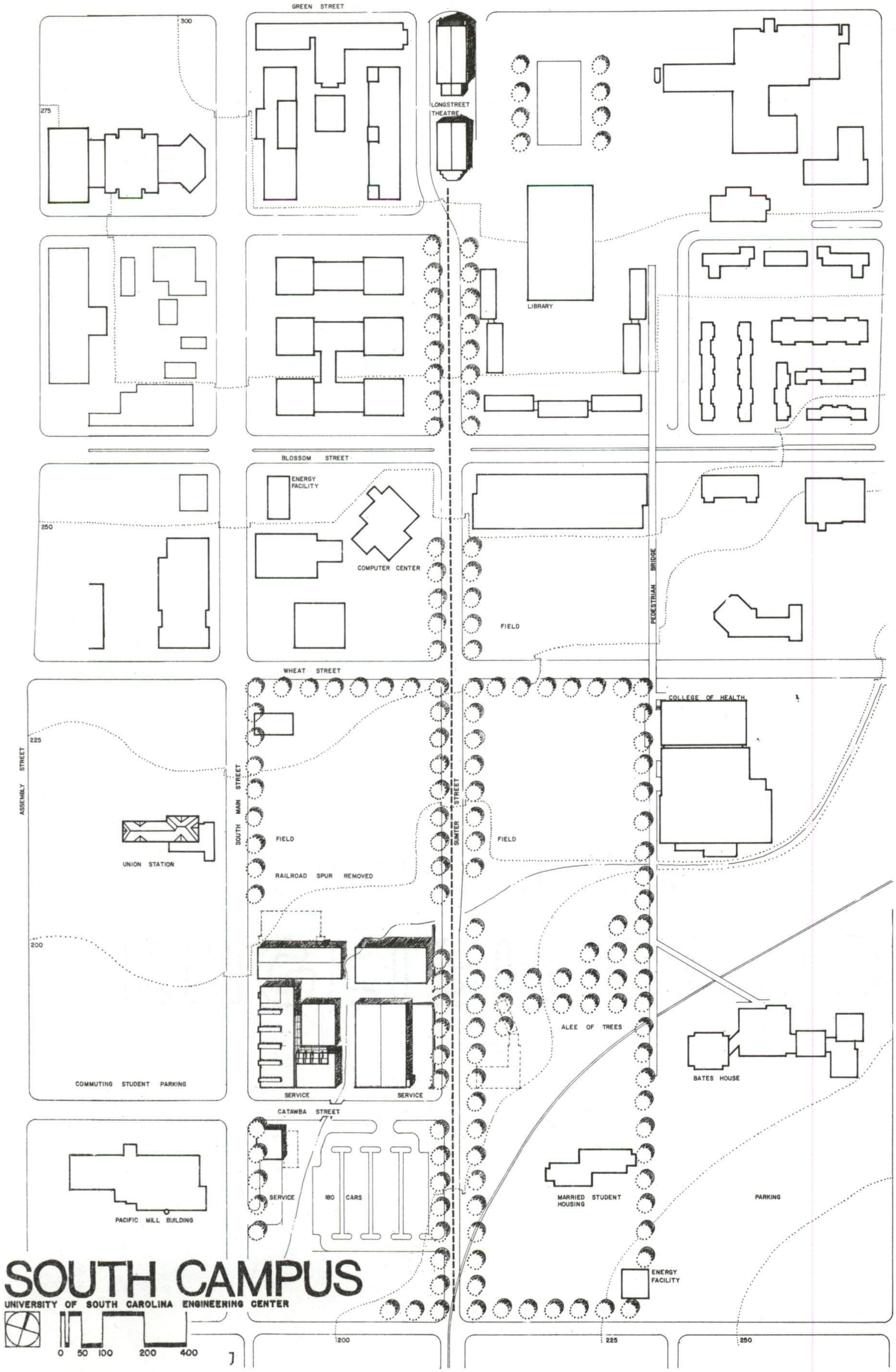
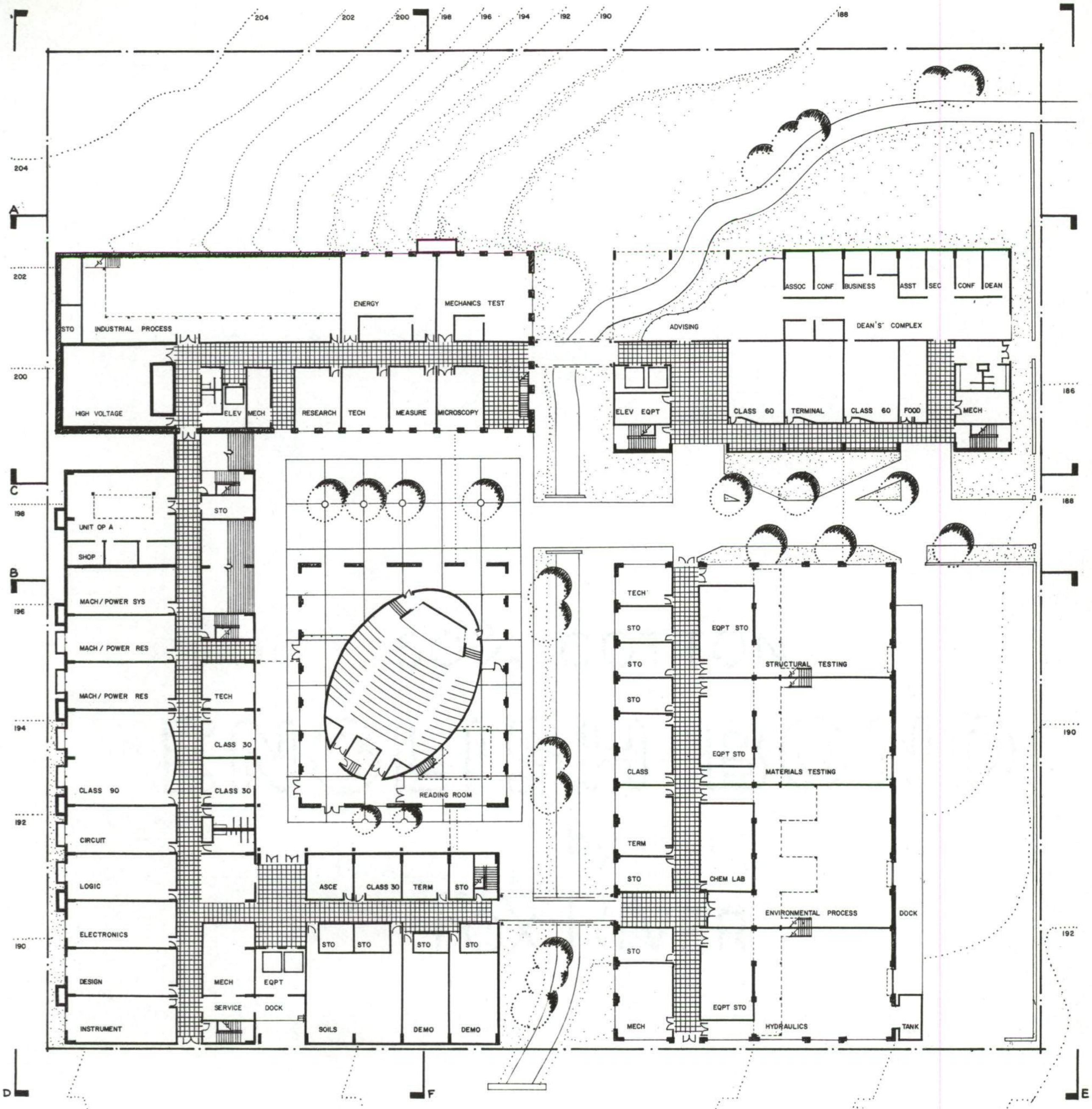
400
600



SOUTH CAMPUS

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER



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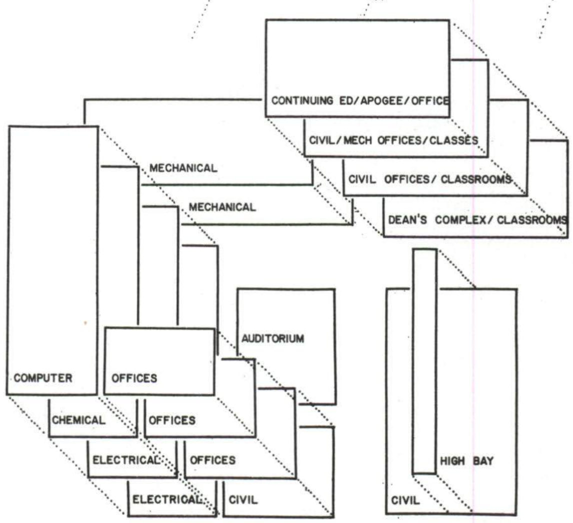
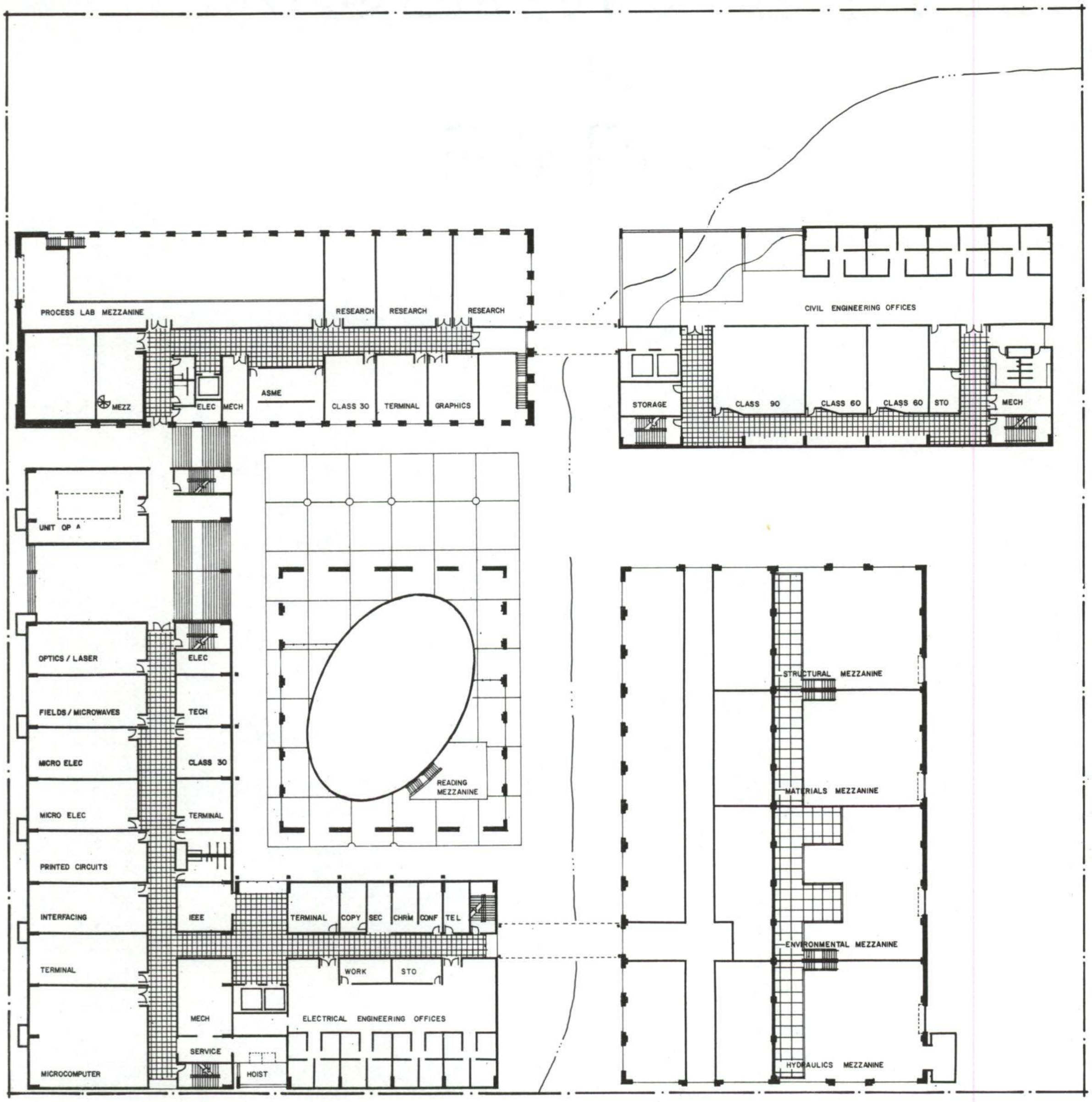
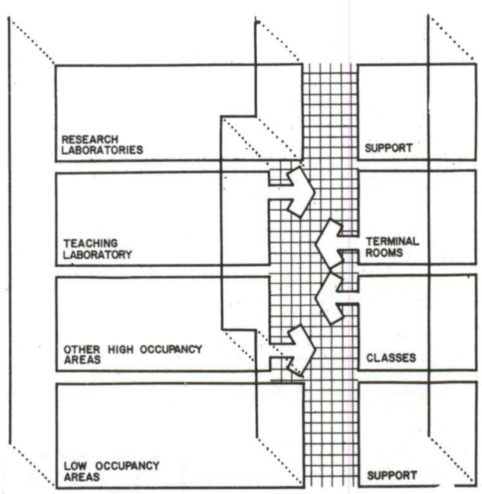
UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER







LEVEL 202

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER

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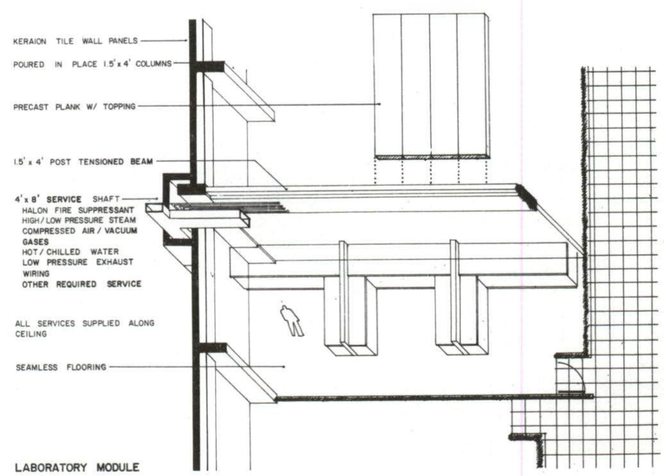

LABORATORY MODULE

LEVEL 216

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER

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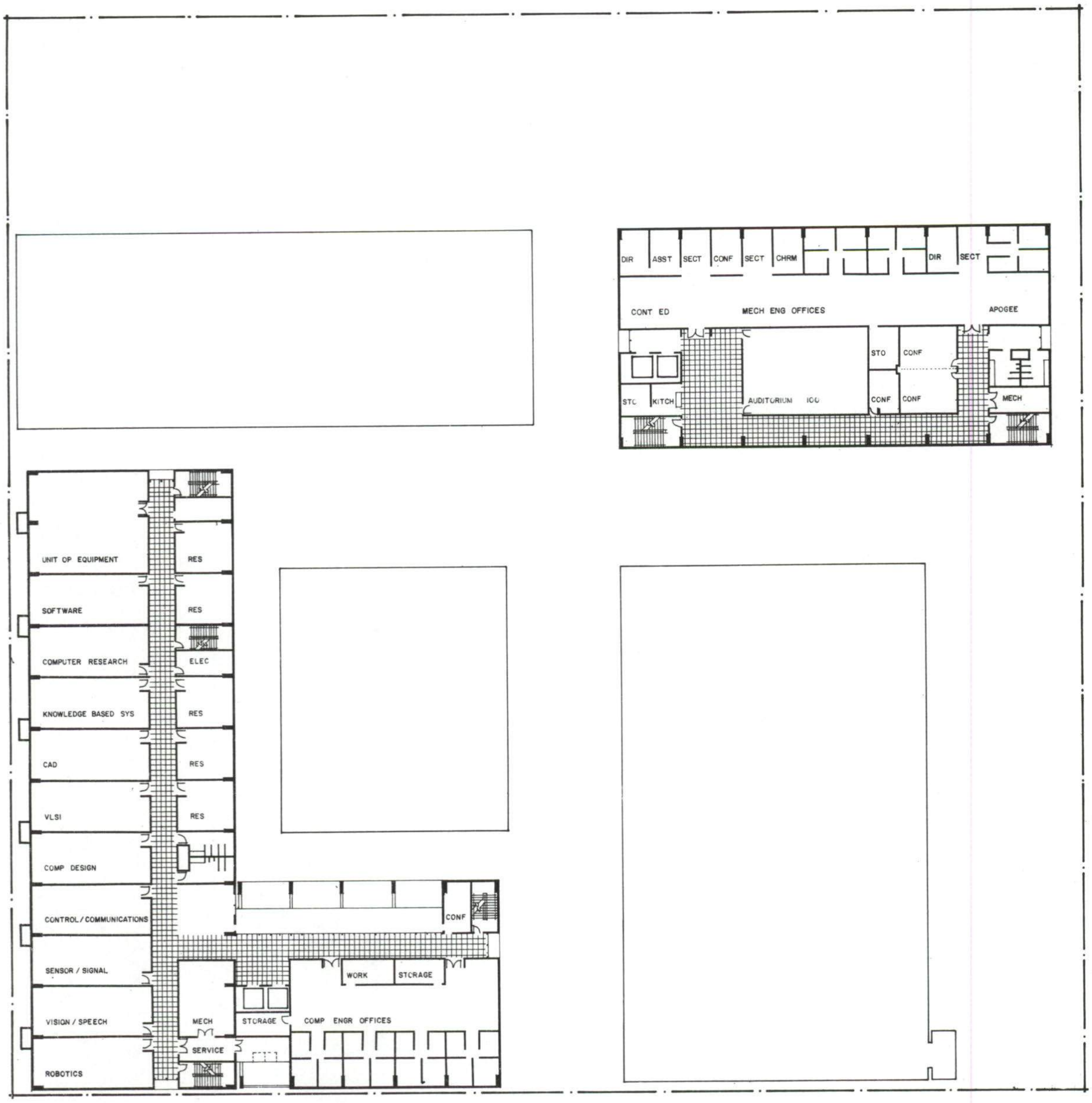
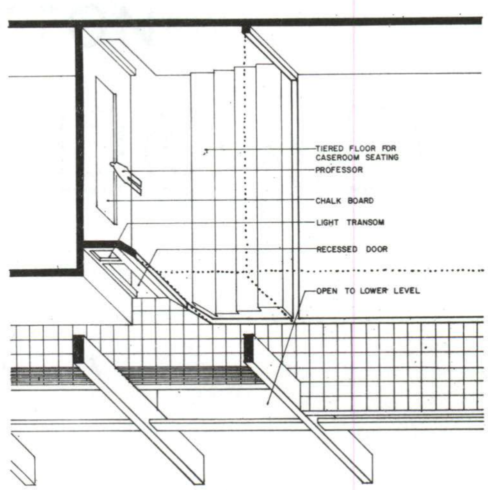
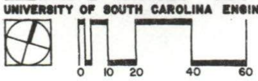




LEVEL 230

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER



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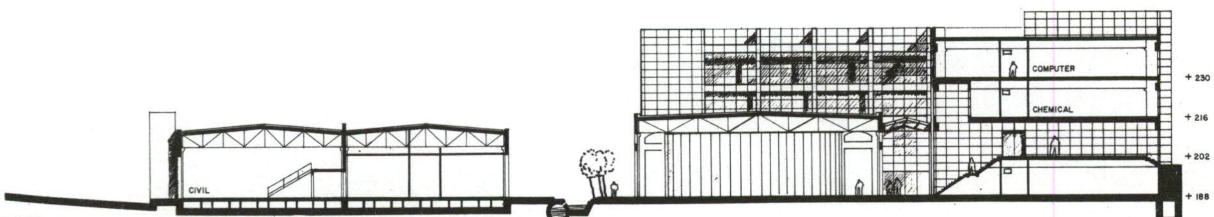

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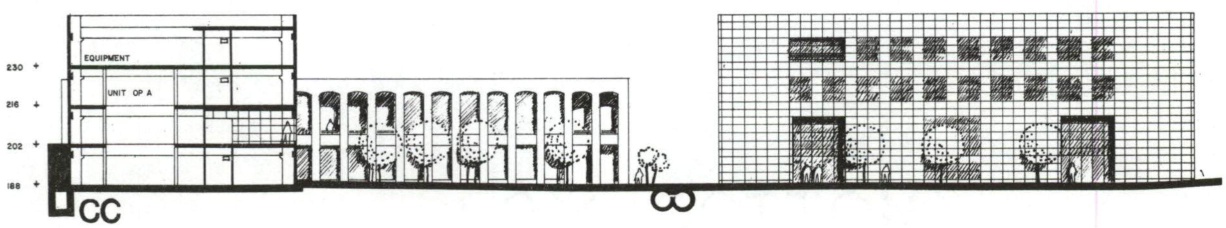

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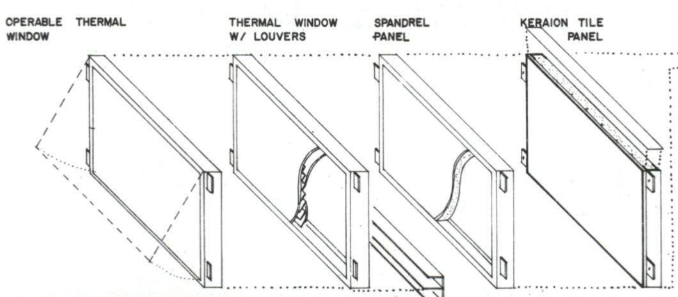

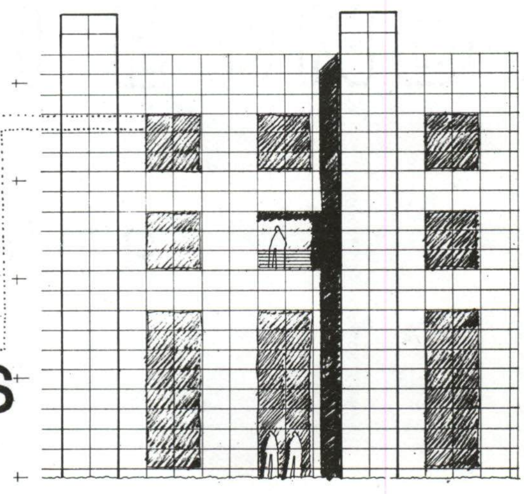

ELEVATIONS/SECTIONS

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER

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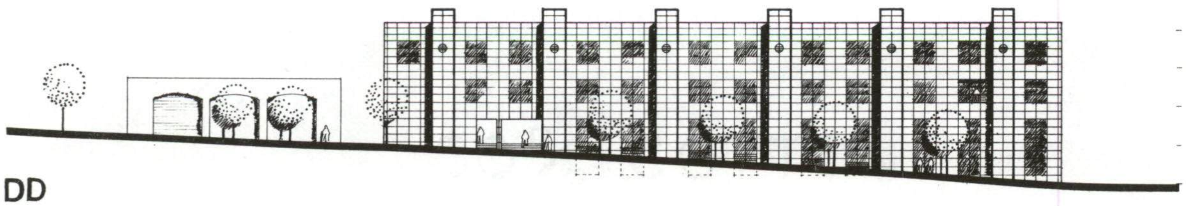

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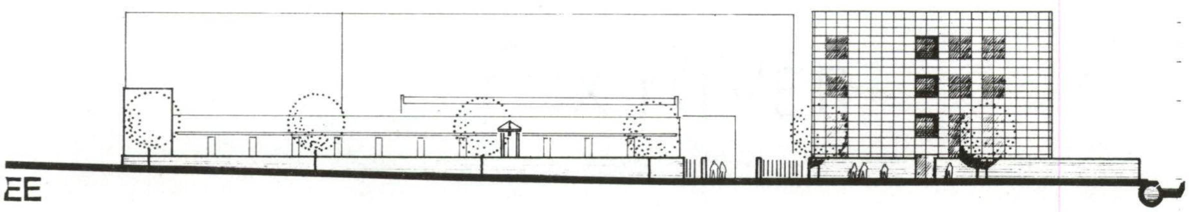

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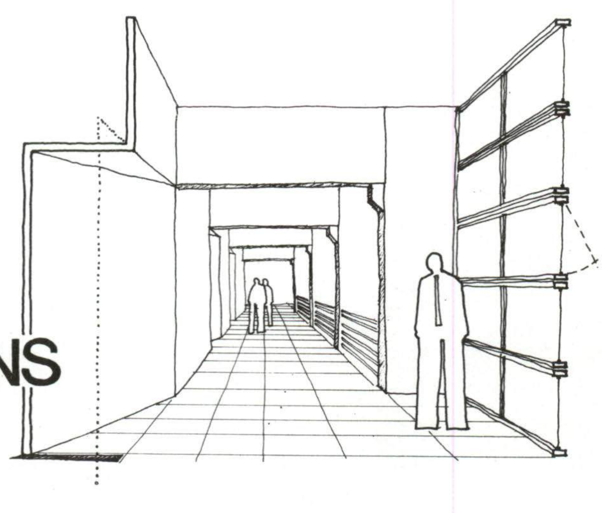

ELEVATIONS/ SECTIONS

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER

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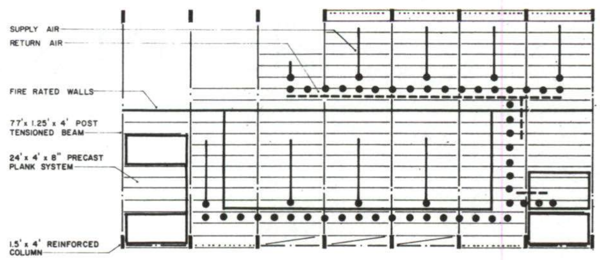
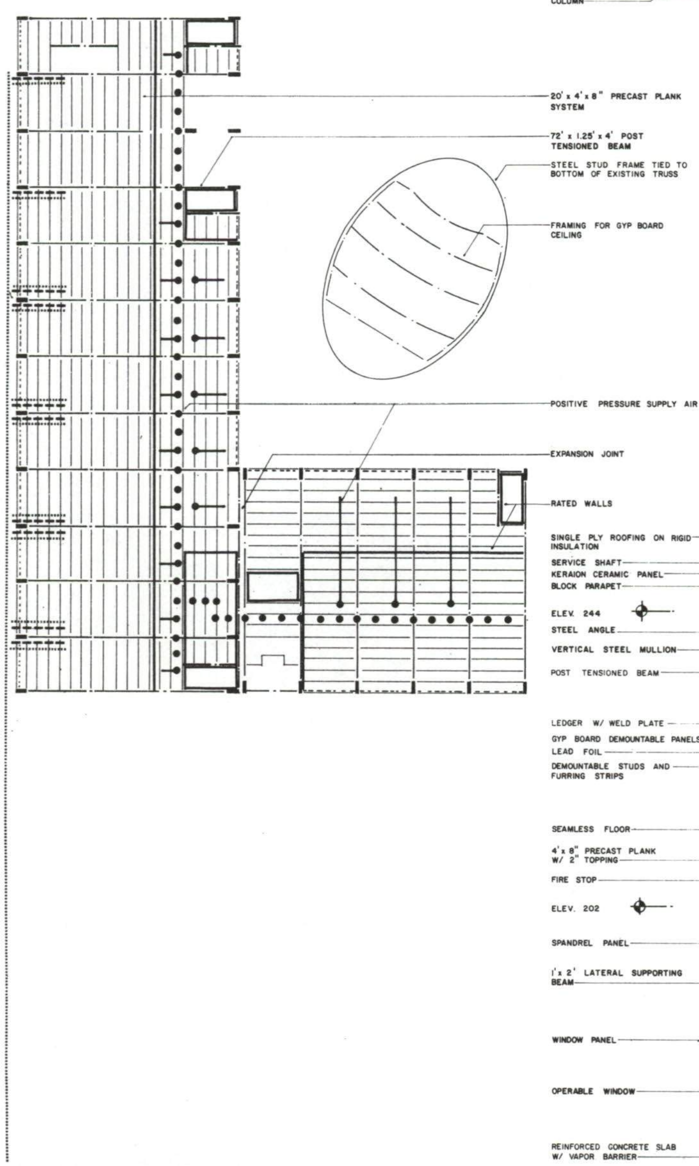
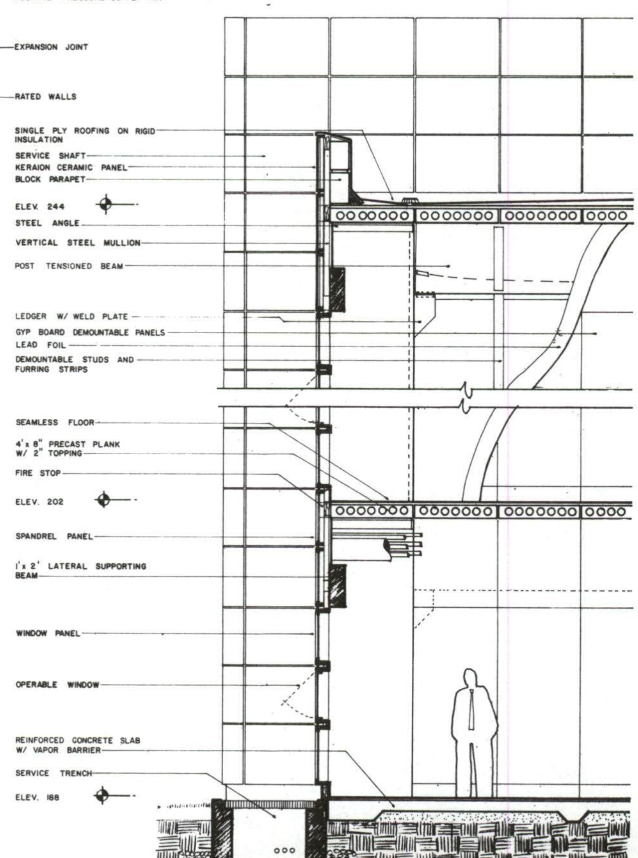
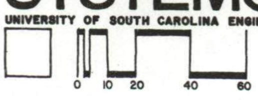


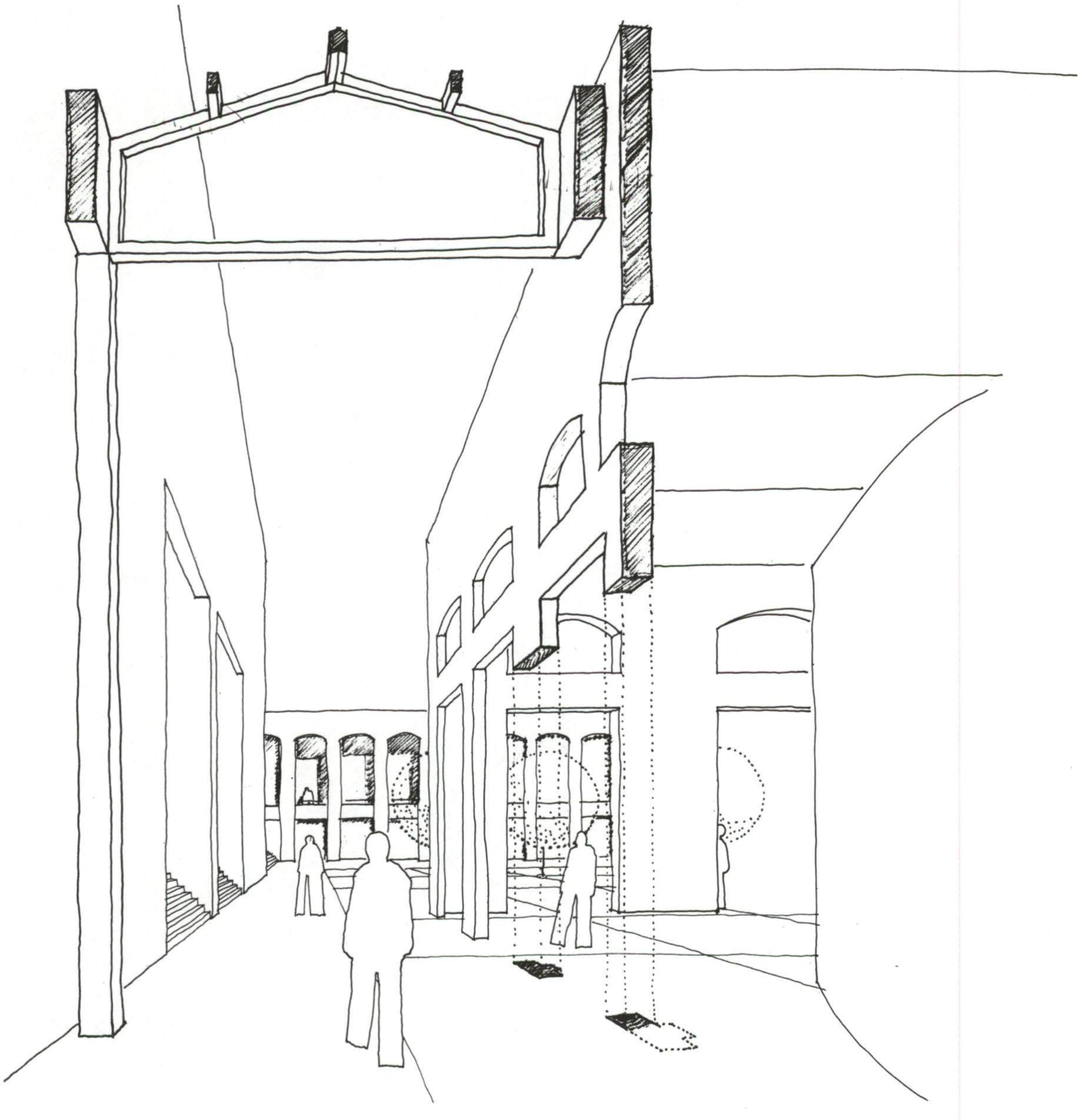




SYSTEMS

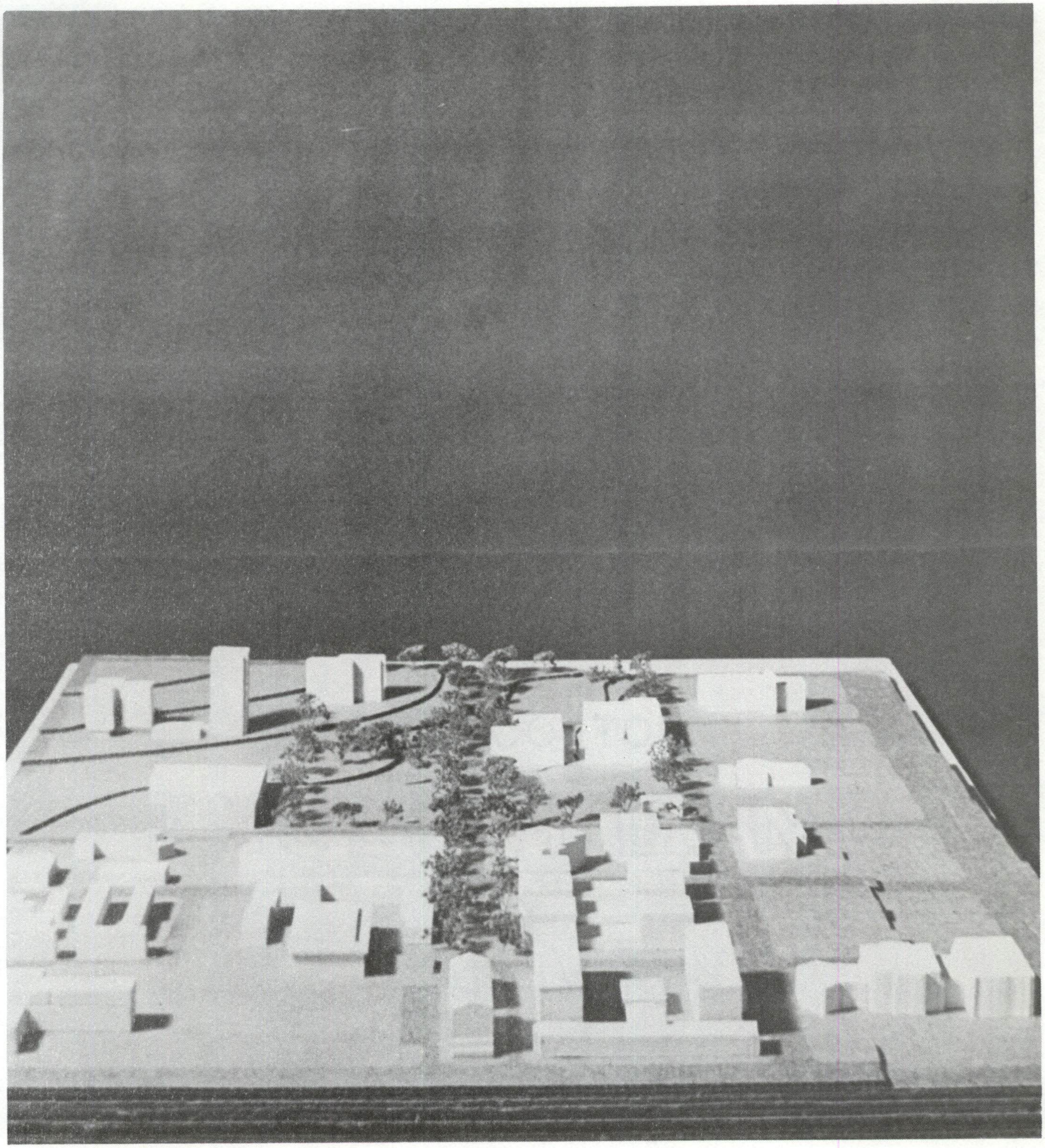
UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER

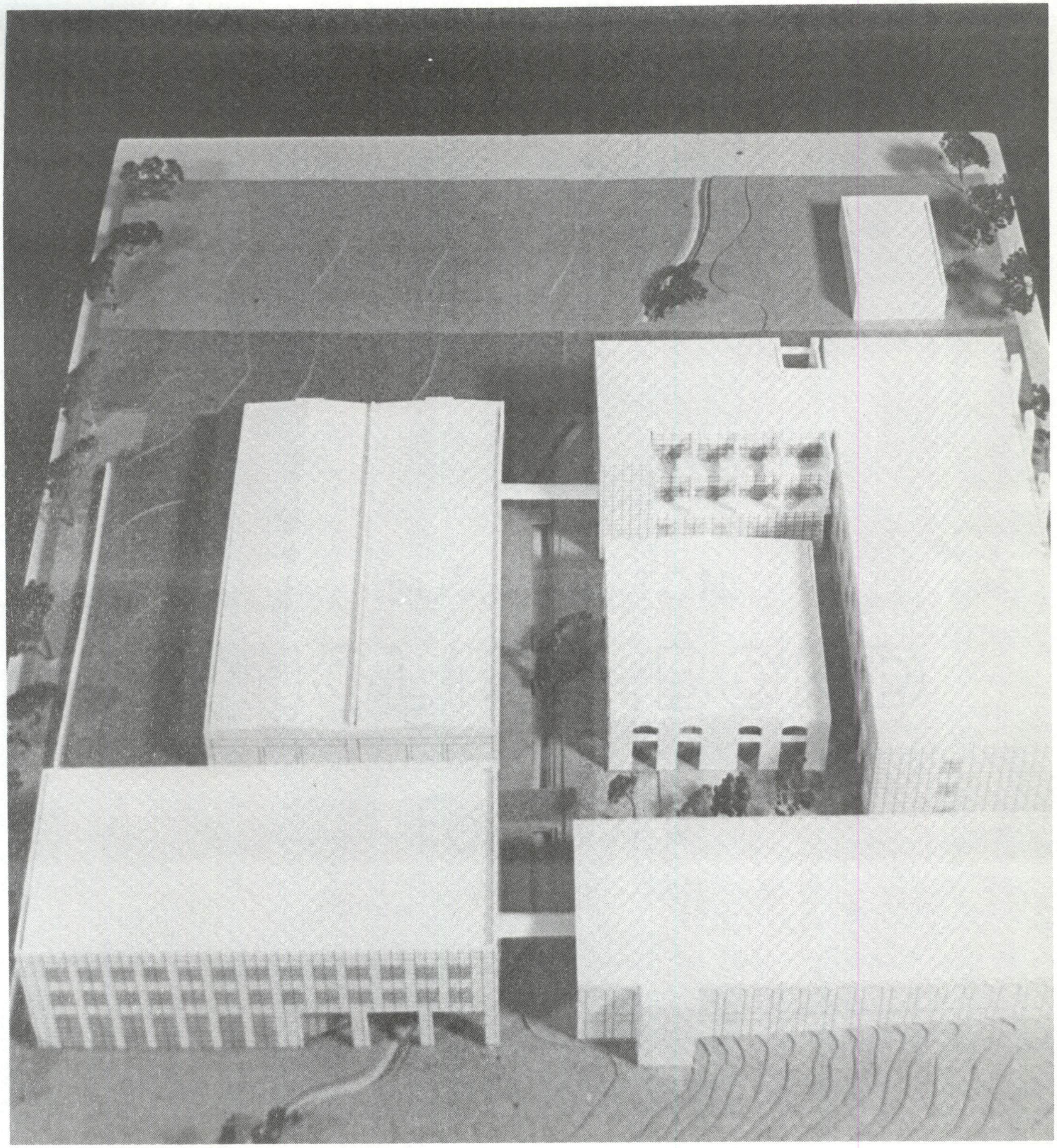




INTERIOR STREET

UNIVERSITY OF SOUTH CAROLINA ENGINEERING CENTER





RESOURCES

CODES AND CONSTRAINTS

The following requirements set forth in the Standard Building Code by the Southern Building Code Congress International apply to the proposed building.

Occupancy Classification: Mixed occupancy with the principal intended use being education.
Construction Type: Type I which allows unlimited height and floor area.

Exit Requirements: In this case, a dry fire extinguishing system such as Halon should be used to allow maximum safety as well as a 200 foot distance of travel between exits.
Number of Exits in an Occupied Area: One for occupancies less than 50 persons. Two for occupancies exceeding 50 persons but less than 500 persons.
Minimum Exit Corridor: 72 inches (note eight to ten feet is more appropriate for moving bulky equipment.)

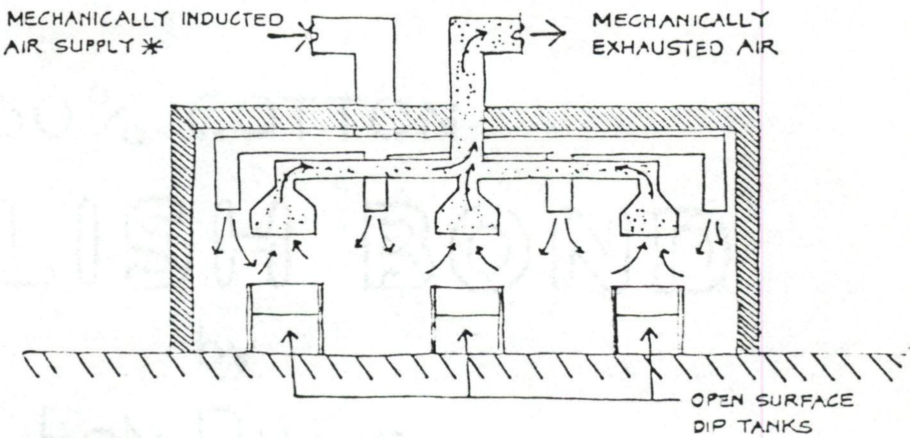
Handicapped Corridor: 44 inches minimum.
Handicapped Ramps: 1 in 12 maximum rise with four foot minimum width.
Handicapped Parking: Six spaces per the required 180 parking spaces.
Handicapped Viewing Areas: Seven spaces in the 400 seat auditorium.

Fire Protection: As classified under Type I construction. Party and fire walls - 4 hour. Columns - 4 hour. Beams - 4 hour. Floor - 3 hour. Roof - 1 1/2 hour. Vertical Shafts - 2 hour.
Fire Protection Between Mixed Occupancy Areas: Not less than 2 hours.

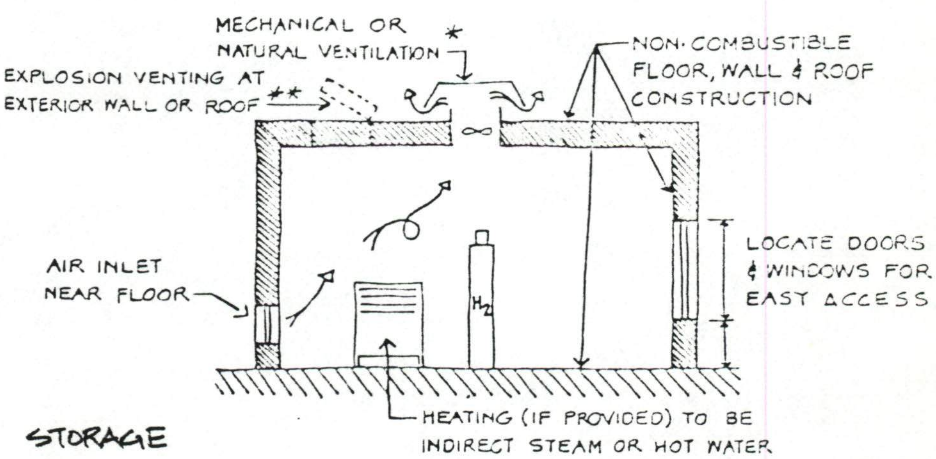
Live Load Criteria: Classrooms, Offices, and Fixed Seat Assembly Areas- 50 pounds per square foot. Public Corridors - 100 pounds per square foot. Laboratories - 125 pounds per square foot.

The follwing criteria are from The Designer's Guide To OSHA (The Occupational Safety and Health Act) and apply to certain storage areas and laboratory areas found in this building.

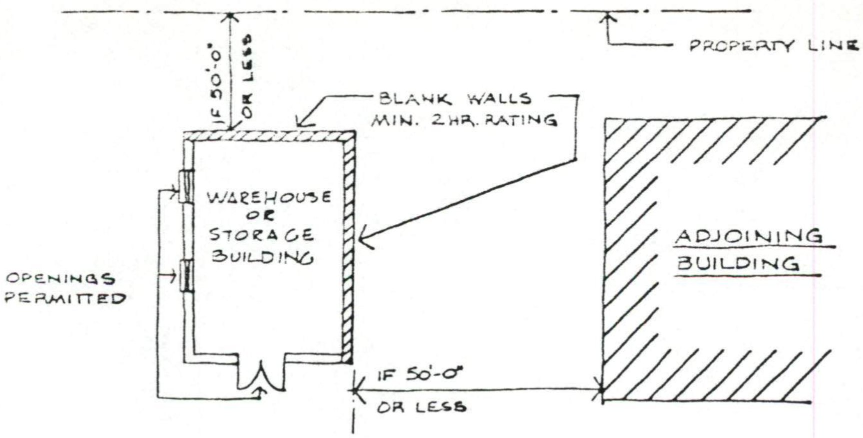
Ventilation: Due to the variety of work conditions in these laboratories, it is necessary to develop hoods adaptable to particular situations in question. All hoods should be located as near as possible to the operation.



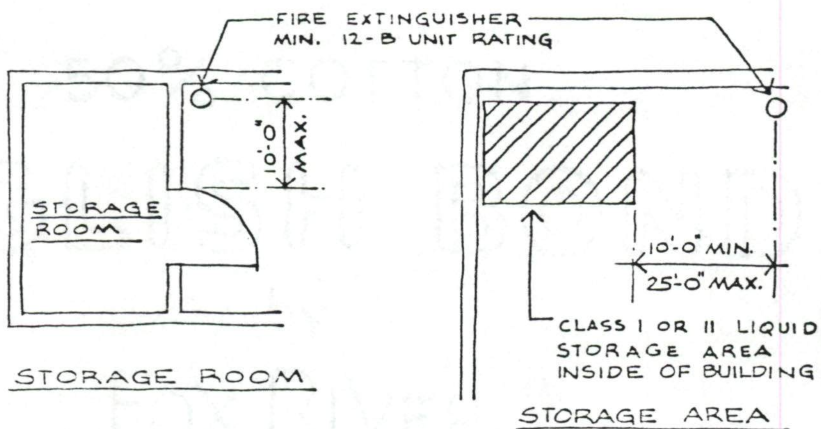
LABORATORIES



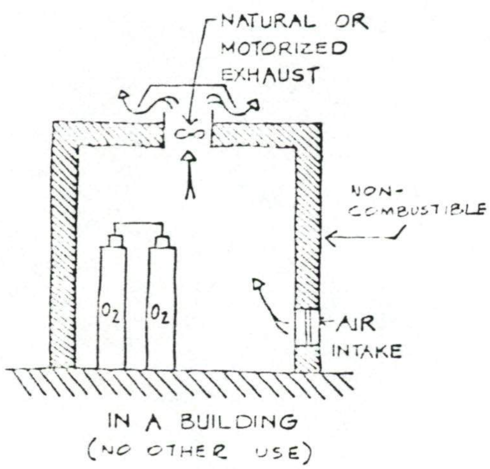
STORAGE



SEPARATE STORAGE AREAS

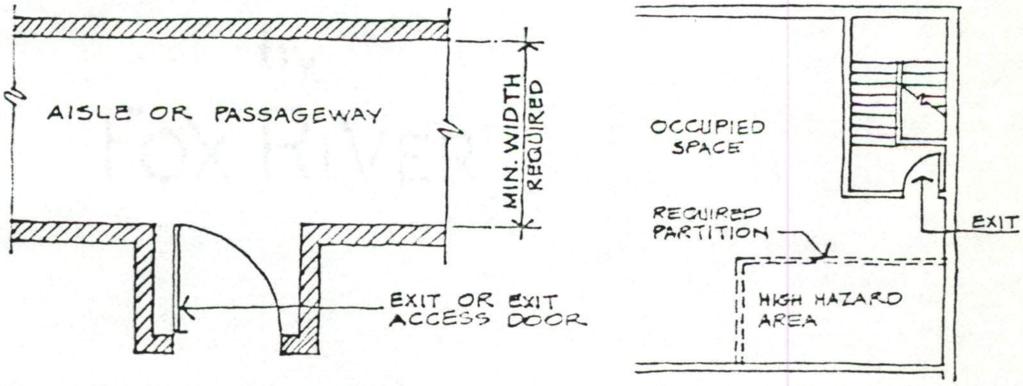


PROTECTION IN STORAGE AREAS

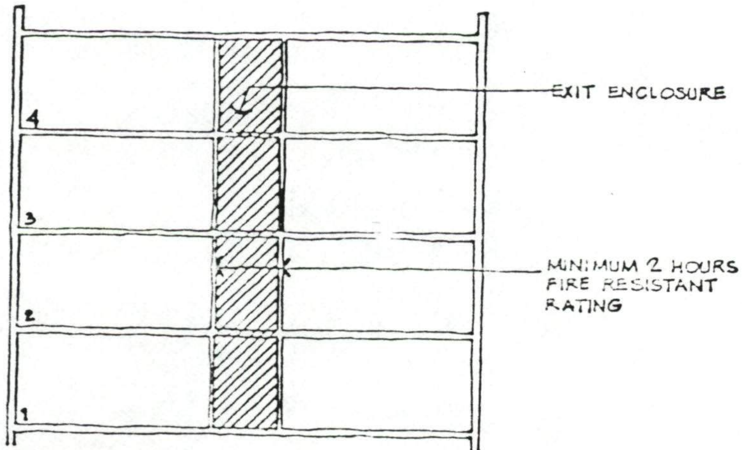


EXAMPLE: VENTILATION FOR OXYGEN STORAGE

Egress: Egress conditions in laboratory areas are important. It is necessary that physical design and storage conditions do not obstruct or create hazardous egress routes.

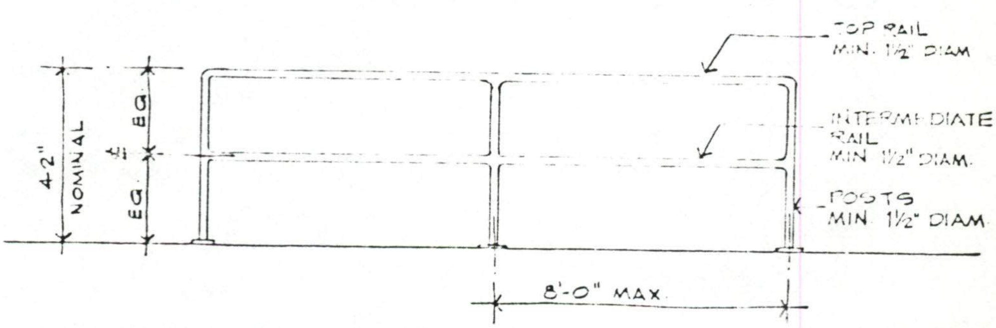


DOOR AND EXIT LOCATIONS



SECTION

(FOUR STORY) CORRIDOR REQUIREMENT



MEZZANINE RAILING REQUIREMENTS

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Bennett, A. Wayne, Ph.D. Head of the Department of Electrical and Computer Engineering, Clemson University, 1984.

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Rinker, David, AIA. Systems Vice President for Facility Planning, University of South Carolina, 1984.